The Welding Engineer

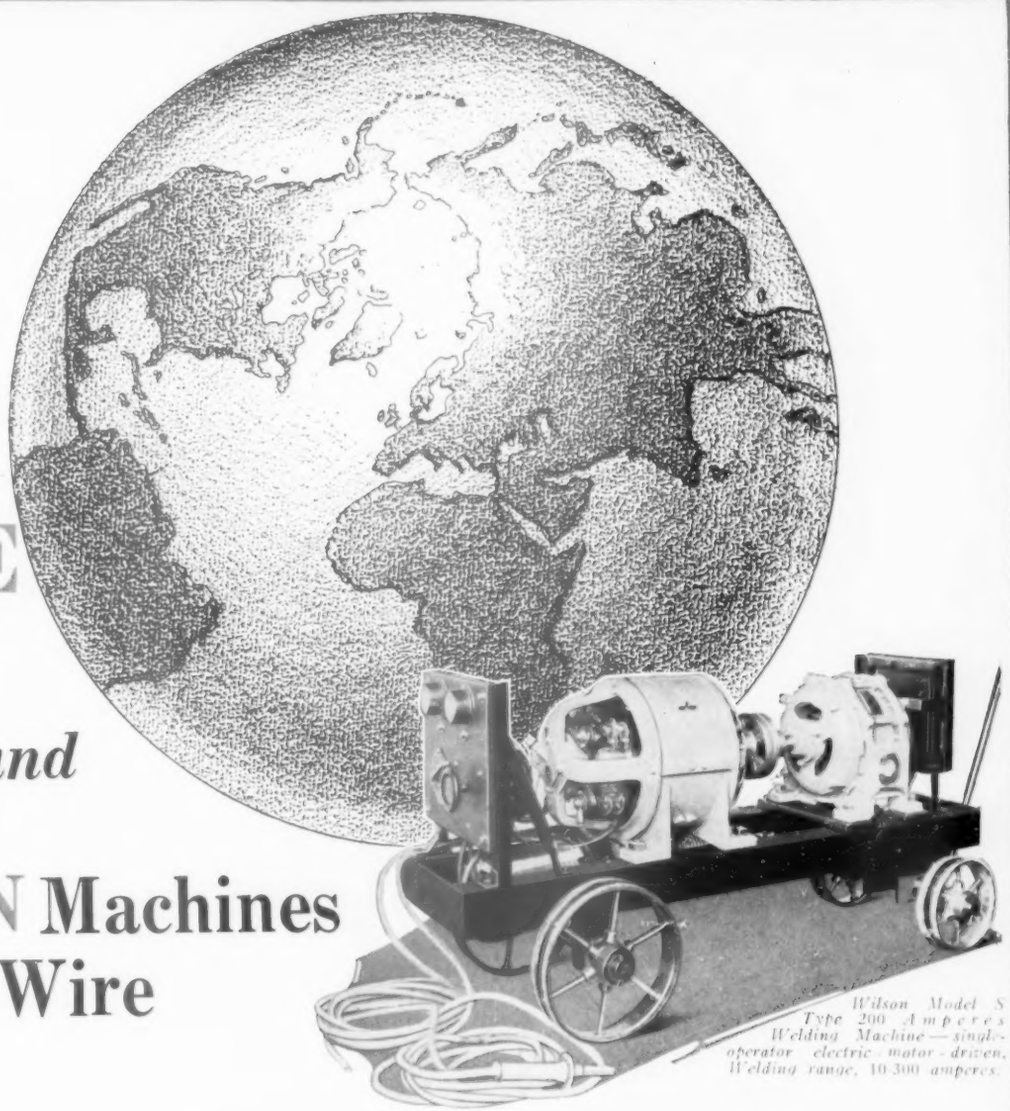
Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

JANUARY, 1929 VOL. 14, NO. 1

$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. $4.00 per year abroad

TODAY from Every Part of the GLOBE comes the demand for WILSON Machines and Wire



Wilson Model S Type 200 Amperes Welding Machine—single-operator electric-motor-driven. Welding range, 10-300 amperes.

TODAY, from every continent, from almost every nation, comes the demand for Wilson Machines and Wire—expressing WORLD-WIDE recognition of the unparalleled efficiency of the WILSON electric weld.

Pioneers in electric welding, Wilson offers to you its long and varied experience—its great accumulation of welding information—without charge or obligation.

Questions are invited. Write today for illustrated bulletins, describing all the Wilson Model S Welding Machines. Also ask for samples of Wilson "Color-tipt" Welding Wire—indicating the kind of metal you desire to weld.

WILSON WELDER & METALS CO. INC., 20 WILSON BUILDING, HOBOKEN, N. J.

WILSON

WELDING MACHINES AND WELDING WIRE

Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

use STOODITE *where metal wears*

RESISTING abrasion . . . withstanding the wear of strenuous use . . . STOODITE, the super-hard facing metal, is constantly bringing profit to industry.

First used in the oil fields as a facing for drilling tools, STOODITE'S effective reaction to twisting or torsional strain, tensility, compression, impact, as well as abrasion, soon proved to the industrial world that it was the *profitable* hard facing metal. And *now*, on heavy road machinery . . . on drills . . . on aeroplane skid shoes . . . in fact, wherever metal is put to unusual wear, STOODITE is bringing *positive results.*

And, STOODITE can be *easily* applied by either the Electric or Oxy-acetylene process.

Write Dept. 3 for a complete description of STOODITE the super-hard facing metal.

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Manufacturers of

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For Automatic Arc Welding "Raco" Composite Type "A" Wire

A WIRE specially developed for use with automatic Arc Welding machines.

The outstanding feature of "Raco" Composite Type "A" Wire is a series of lengthwise grooves containing a most efficient arc stabilizing material which cannot be chipped out by the feed rollers.

A perfect contact is insured due to the absence of flux on outside of wire and also due to the fact that the wire is solid rather than made up of several units.

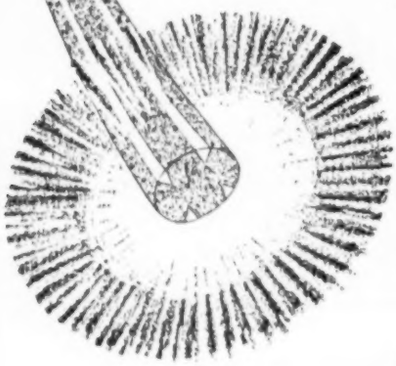
We are able to guarantee highest possible speed, absolute uniformity and arc stability with the finest possible quality of welds.

The prices are considerably lower than is usual on wires ordinarily used for Automatic Arc Welding on account of the relatively high speed with which our continuous process produces our finished product.

All "Raco" Composite Type "A" Welding Wire is furnished in standard compactly wound coils which exactly fit our special reels. These reels are interchangeable with reels generally used with Automatic Welding Heads and will fit present mountings.

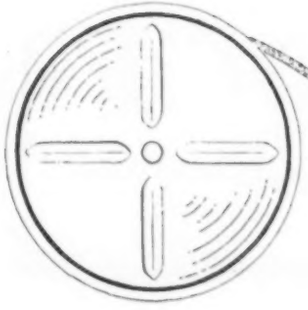
Shipping the wire in coils saves incoming and outgoing freight on a considerable number of reels also the deposit on reels while in customer's hands.

One special reel at nominal cost is needed for each automatic welding head in operation.



The widespread success that has rewarded the efficiency of this wire is attested by the fact that today practically every large installation of automatic arc welding machines in the country is using "Raco" Composite Type "A" Wire.

If you will advise us what size wire you are using at the present time we will be happy to forward you samples for test purposes—all charges prepaid—and quote you prices.



REID-AVERY CO., Inc.

21st and Washington Avenue Philadelphia, Penna.

Works: Baltimore, Md.

Announcing the New

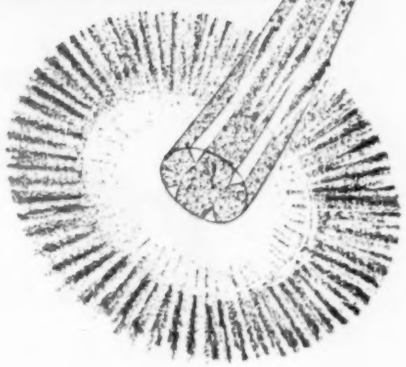
"Raco" Composite Type "B" Electrode
for Manual Welding

THIS Electrode is of standard .13 to .18% carbon analyses and each rod has lengthwise grooves rolled into its entire length. These grooves are filled with a remarkable arc stabilizing agent. Due to its construction we are able to guarantee absolute uniformity with no rejections from any cause whatsoever. *This electrode has splendid penetration and high welding speed in addition to absolute uniformity.* We do not believe that uniformly satisfactory results can be obtained over a period of time with a bare electrode, and Raco Composite Type "B" Wire has been perfected with a view of getting away from inequalities of bare wire. The arc stability of this new wire is so perfect that it may be used with equal success with either D.C. or A.C. current where Flux Coated Electrodes have been considered necessary. The cost of this electrode is no more than a good grade of bare wire and means absolute satisfaction. It is the most reliable electrode on the market for straight production use.

We also manufacture Raco "Red Label" (Copper Coated) rods for gas welding in both pure iron and mild steel grades. These rods are unqualifiedly guaranteed to be the finest quality on the market today.

In addition to the rods mentioned above are "Raco" .95 — 1.10 high carbon rods and "Raco" 3½ percent nickel steel rods.

Samples of any of these rods will be cheerfully furnished on request, charges prepaid. Please advise sizes desired.



DEALERS ATTENTION: We have at present a most attractive proposition in some very desirable territory. Write us at once.

REID-AVERY CO., Inc.

21st and Washington Avenue Philadelphia, Penna.

Works: Baltimore, Md.

IN EMERGENCIES . . .
IT'S *SERVICE* THAT COUNTS

You'll find that a Welding Rod of Chase Chāmet† Bronze measures up to all you expect in a good Bronze alloy; strong, close grained, free flowing, easy machining.

But quality isn't everything — sometimes, on a rush job, *service* is a vital factor. And we are always in a position to give you prompt deliveries.

With completely stocked warehouses in thirteen strategic centers from coast to coast when it's a case of "rush" you'll find that Chase service will meet your needs.

The Mark that Identifies Good Brass and Copper Products

The Mark that Identifies Good Brass and Copper Products

† *Chase Chāmet Bronze Welding Rod is made from our own special mixture which we have named Chāmet to distinguish it from ordinary bronzes. Details regarding tensile strength, elasticity and machining properties gladly furnished upon request.*

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Chāmet Bronze Welding Rod
Chase Manganese Welding Rod
Chase Brass Welding Rod

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* WAREHOUSE STOCKS ARE CARRIED IN THESE CITIES

The Mark that Identifies Good Brass and Copper Products

The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 14 | January, 1929 | Number 1

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An Important Exception

PART of a recent newspaper advertisement gave prominent display to the offer of "A 20% Reduction on all items in this department—except nationally advertised brands." The exception is an important one, because it shows what the up-to-date merchandiser expects from the public. He expects buyers to have a definitely larger confidence in the qualities of goods which stand the test of advertising year in and year out, and to be willing to pay a slight premium to get those qualities, and to be assured of satisfaction rather than disappointment. This country is a vast market, and a prosperous market. It is a market where the combination of quality merchandise and intelligent advertising cannot fail to build profitable business. The tendency of some buyers to play price-cutters against one another is often misinterpreted to indicate that price is the big thing in selling. However the dominant factors in most industries are usually those who manufacture quality products and advertise them consistently. There are many who consider that the general appreciation of quality and willingness to pay for it is an important factor in the maintenance of our prosperity.

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Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
Prest-O-Lite Co.
Superior Oxy-Acetylene Co.

ACETYLENE CYLINDERS
Keith Dunham Company
Pressed Steel Tank Co.

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Keith Dunham Company
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Miller Aluminum Solder Co.
Weldene Corporation

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Westinghouse Elec. & Mfg. Co

APRONS (Asbestos)
Ideal Face Shield Co.

ASBESTOS INSULATED WIRE AND CABLE
Central Steel & Wire Co.

BLOW PIPES
See "Torches."

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Williams & Co.

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Central Steel & Wire Co
Chase Brass and Copper Co., Inc.
Mueller Brass Co.
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Superior Oxy-Acetylene Co.
Steel Sales Corp.

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R. G. Haskins Co.
N. A. Strand & Co.

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See "Electric Resistance Welders"

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Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Lincoln Electric Co.
Quasi-Arc Weldtrode Co.
Una Welding and Bonding Co.
U. S. L. Battery Corp.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CARBIDE
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National Carbide Co.
Shawinigan Products Corp.
Superior Oxy-Acetylene Co.
Union Carbide Sales Co.

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Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
National Carbon Co.
Oxweld Acetylene Co.

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Bastian-Blessing Co.
Craftsweld Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.

CAST IRON SOLDER
Crown Aluminum Solder Co.
Superior Oxy-Acetylene Co.
Weldene Corporation

CAUSTIC POTASH
Innis, Speiden & Company

CONSULTING ENGINEER
E. F. Hollinger
R. E. Kinkead
R. C. Pierce

CONTRACT WELDERS
S. O. S. Welding Corp.

CUTTING ELECTRODES (Electric Arc)
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Electric Arc Cutting & Welding Co
General Electric Co.
Lincoln Electric Co.
National Carbon Co.
Una Welding and Bonding Co
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CYLINDERS (Acetylene)
Keith Dunham Company
Pressed Steel Tank Co.

CYLINDERS (Oxygen, Hydrogen)
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Wm. Wharton, Jr. Co.
Harrisburg Pipe & Pipe Bending Co.

DRILLS, PORTABLE ELECTRIC
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R. G. Haskins Co.
Stoody Company
N. A. Strand & Co.

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Chicago Steel & Wire Co.
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Electric Welding Machine Co.
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Goodman Electric Machinery Co.
Gibb Welding Machines Co.
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E. A. Lundy Co.
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See "Cutting Electrodes"

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Atlas Foundry Co.
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Gibb Welding Machines Co.
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Koro Corporation
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Page Steel & Wire Co.
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Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
Standard Steel & Wire Co.
Steel Sales Corp.
Stoody Company
Una Welding and Bonding Co.
Welding Service Co.
Wickwire Spencer Steel Corp.
Williams & Co.
Wilson Welder & Metals Co.

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Chicago Steel & Wire Co.
Electric Welding Machine Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Koro Corporation.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Stoody Co.
Superior Oxy-Acetylene Co.
Waters Arc Welding Corporation
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRODE TIPS (Resistance Welding)
Elkon, Inc.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
International Oxygen Co.

FACE SHIELDS (Arc Welding)
Allan Mfg. Co. & Welding Co.
American Optical Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Stoody Company
Superior Oxy-Acetylene Co.
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.
Willson Goggles, Inc.

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Air Reduction Sales Co.
American Brass Co.
American Steel Engineering Co.
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Craftsweld Equipment Co.
Fusion Welding Corporation
C. H. Hollup Corp.
Imperial Brass Mfg. Co.
Krembs & Co.
Mueller Brass Co.
Koro Corporation
Oxweld Acetylene Co.
Page Steel & Wire Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
St. Paul Welding & Mfg. Co.
Standard Steel & Wire Co.
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Stulz-Sickles Co.
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Torchweld Equipment Co.
Welding Service Co.
Wickwire Spencer Steel Corp.
Weldit Acetylene Co.
Williams & Co.

FIREPROOF PLASTIC MATERIAL
Air Reduction Sales Co.
Joseph Dixon Crucible Co.
National Carbon Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
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Anti-Borax Compound Co.
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Central Steel & Wire Co.
Gold Seal Mfg. Co.
Krembs & Co.
Modern Engineering Co.
Momac Sales Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Simplex Flux and Solder Co.

A NEW LINE FOR WELDERS

By this Trade Mark you will know a new excellence

Here's a new line of welding and cutting equipment that is creating astonishing interest wherever it is shown.

XCEL
TRADE MARK
THE SUPERIOR OXY-ACETYLENE CO.
ST. LOUIS, MO.

YOU'LL be surprised at the improvements over the equipment you are now using. Unknown convenience! Unsuspected performance—tools that have the very touch the welder has always sought! Ideas and suggestions of thousands of welders combined with the long years of experience of America's Master Welder—P. F. Willis.

In Xcel are found the performance, appearance and economy to satisfy the most discriminating mechanic. *There is an Xcel Torch for every purpose.*

FREE for the asking

Our new book for the welder

It lists and describes the complete new Xcel line of welders' needs, but it is more than a catalog. It is just chock full of information, facts, and data you will be glad to have and can use daily.

Any one of the articles appearing in this new book may be worth many dollars to you. It is compiled and edited by men who know welding. It is truly a welder's daily handbook.

It's free to you if you are a welder. Write nearest office on your business letterhead.

Free

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4916 Connecticut Street ~ ~ St. Louis, Mo.

OR

The **Kansas Oxy-Acetylene Co., Inc.**
402 East 29th Street ~ ~ Wichita, Kansas

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Torchweld Equipment Co.
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Craftsweld Equipment Co.
Harris Calorific Co.
M. Keith Dunham
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Milburn, Alexander Co.
Modern Engineering Co.
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Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
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General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
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Westinghouse Elec. & Mfg. Co.
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Wilson Welder & Metals Co.
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HOSE COUPLINGS
Carl A. Norgren Co.
See also under "Needle Valves"

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Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.

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Craftsweld Equipment Co.
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International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Co.
Torchweld Equipment Co.
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Torchweld Equipment Co.

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See "Fire Proof Plastic Material"

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Wilson Welder & Metals Co.

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Bastian-Blessing Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.

NICHROME WELDING WIRE
Driver-Harris Co.

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Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.

OXYGEN
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American Oxygen Service Co.
Buckeye Oxygen Co.
Gas Products Association
International Oxygen Co .
Linde Air Products Co.
Superior Oxy-Acetylene Co.

OXYGEN PRODUCTION PLANTS
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Electric Arc Cutting & Welding Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Wilson Welder & Metals Co.
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Una Welding and Bonding Co.

RAIL JOINT WELDERS
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See "Electric Resistance Welders"

SILVER SOLDER
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SWEDISH IRON WELDING WIRE
Bissett Steel Co.

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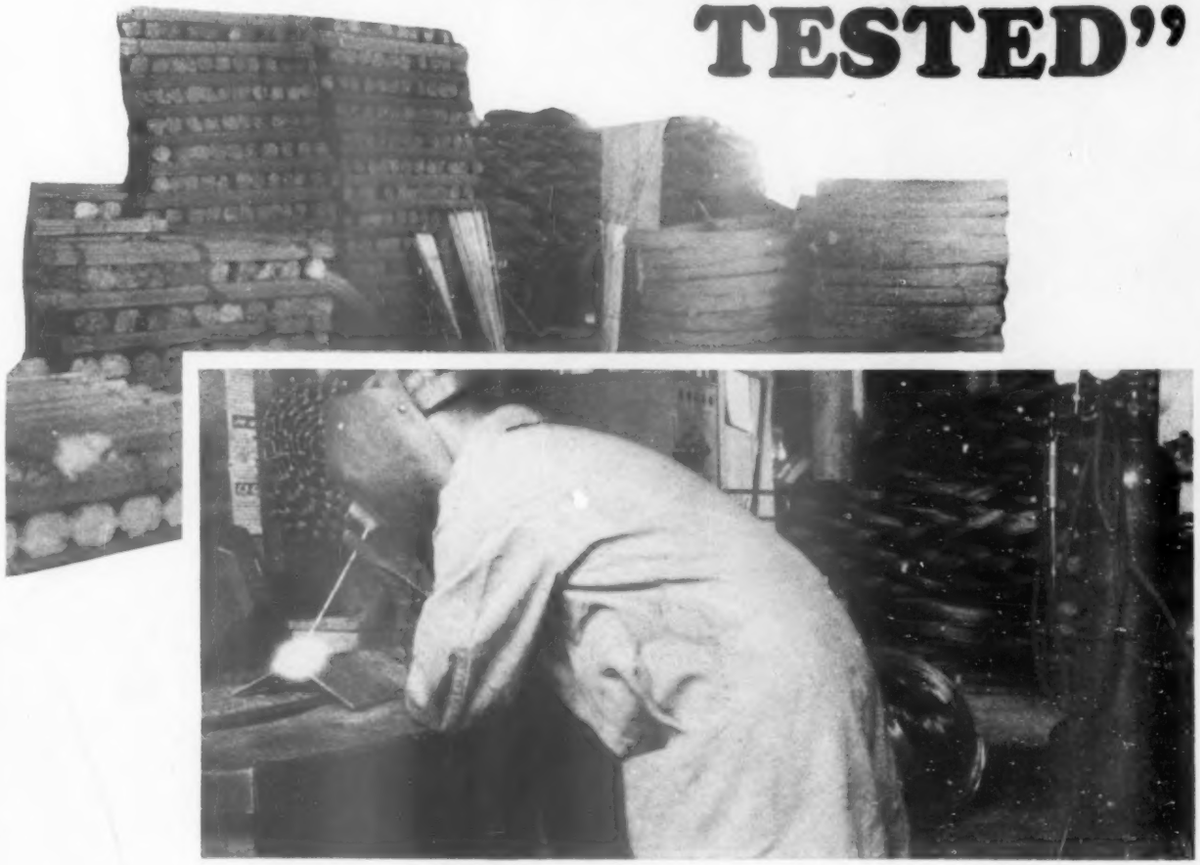
"Every Bundle Must Be TESTED"



ACCESSORIES FOR WELDERS

A complete stock of all welding accessories, including goggles, helmets, shields, gloves, electrode holders, lenses, etc., is carried in each of our three warehouses. Include whatever accessories you need in your next order.

OUR testing laboratory guarantees that quality of "certainty" to SWEDOX Welding Wire, which has maintained its popularity in the welding departments of America's foremost plants. If you start your job with SWEDOX you may be sure that it has come from a stock which has made good under test, and that it will continue to weld smoothly, uniformly, until the work is complete.

Central Steel & Wire Company

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4545 S. Western Blvd.
Lafayette 8500

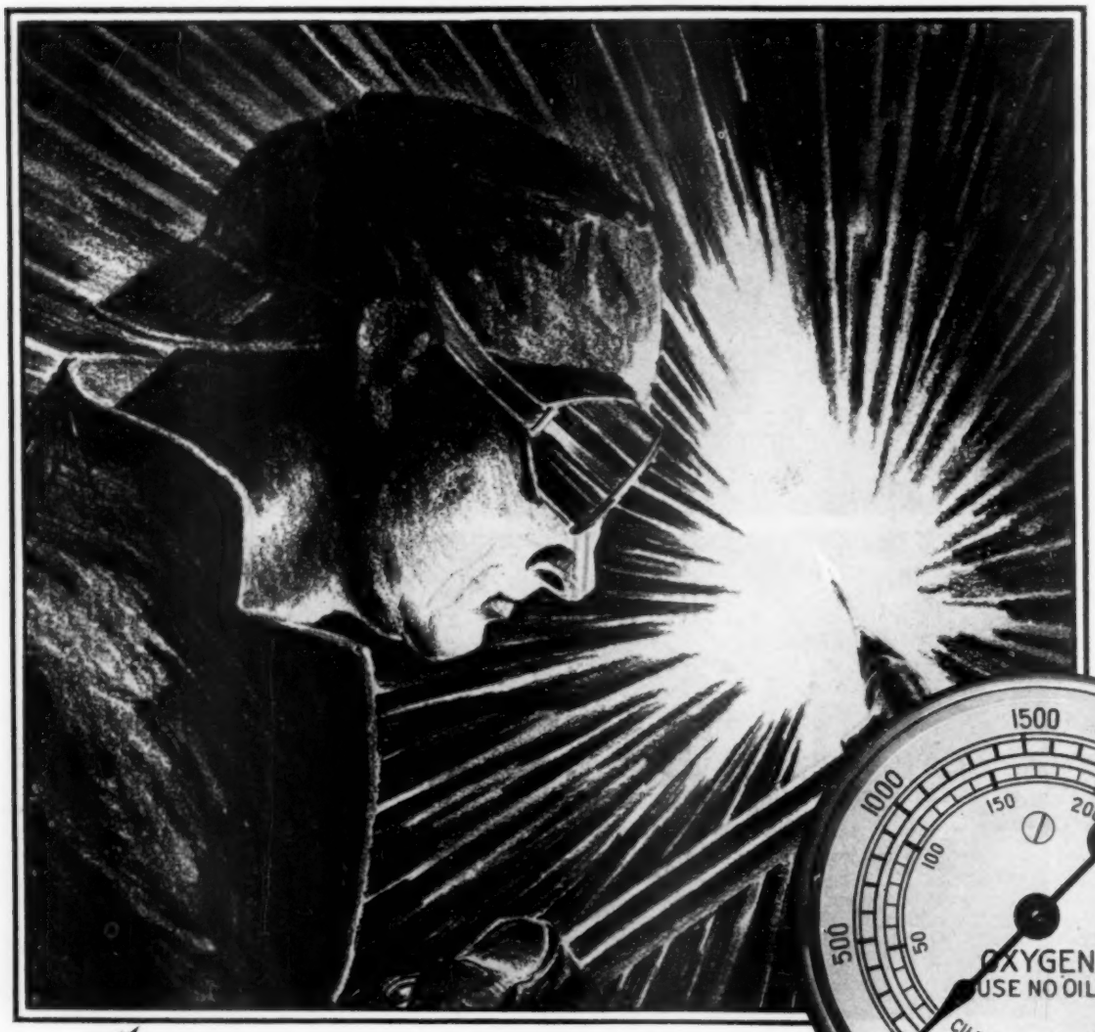
DAYTON, OHIO
East Monument Ave.
Extended
East 150

DETROIT, MICH.
5001 Bellevue Ave.
Whittier 6780

We are distributors for
MASTERMETAL
Trade Mark Reg. U. S. Pat. Off.
ALUMINUM SOLDER
This product is carried in stock in our warehouses at Chicago, Detroit and Dayton.

SWEDOX

WELDING RODS, WIRES and ELECTRODES



The Court of Last Resort

THAT Natweld Gauges meet every requirement of the Underwriters' Laboratories, and are approved by them, is self-evident.

That Natweld Gauges are made by an organization rich in many years' experience of gauge manufacturing, is also a truism.

But Natweld Gauges have a greater claim on your appreciation. They have been accorded a verdict of unanimous satisfaction at the court of last resort—the user.

No better proof of this widespread acclaim need be mentioned than the fact of world-wide demand. This demand has become so great that volume production has enabled us to make prices for this *better* line of gauges that are surprisingly low.

Represented in Illinois, Indiana, Wisconsin, Minnesota, Missouri by Joseph Halla, 333 No. Michigan Ave., Chicago

Chicago Office, 820 Tower Court (MotoMeter Co. of Canada, Ltd.)

Eastern Office, 15 Wilbur Ave., Long Island City, N. Y.

National Gauge & Equipment Co.

La Crosse, Wisconsin

Division of the MotoMeter Co., Long Island City, N. Y.

ELECTRIC WELDING

REQUIRES AN EFFICIENT TRANSFORMER

In choosing the transformer for your welding machine, three factors are of utmost importance:

1. Flexibility—(to suit any circuit).
2. Reliability—(24 hour service, without interruption, if necessary).
3. Economy—(long life with a minimum of repairs).

The American Transformer Company has consistently endeavored to uphold these standards of efficiency. In the welding industry they have closely followed each new development. The result is a staff of engineers competent to advise you on your electric welding problem regardless of its unusualities. Their advice entails no obligation, of course.

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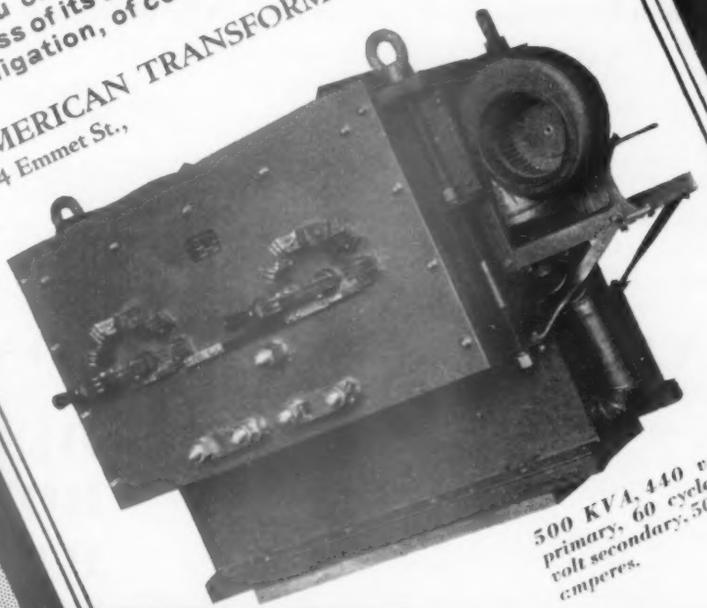


500 KVA, 440 volt primary, 60 cycle 10 volt secondary, 50,000 amperes.

AMERICAN TRANSFORMER

For Molds,

Cores, Dams,

Electrodes

National Welding Carbon Products

FOR any welding operation there are National Welding Carbon products that will assist the welder greatly in doing the best kind of job, more quickly. For gas welding, carbon blocks, rods, paste and flour are particularly valuable for the building of molds, cores, dams, and the shielding of adjacent parts from the heat of the flame.

For electric welding the same products find similar uses, and in addition there are National Welding Carbon Electrodes. These are in increasing demand as the special advantages of the carbon arc meet more and more welding conditions.

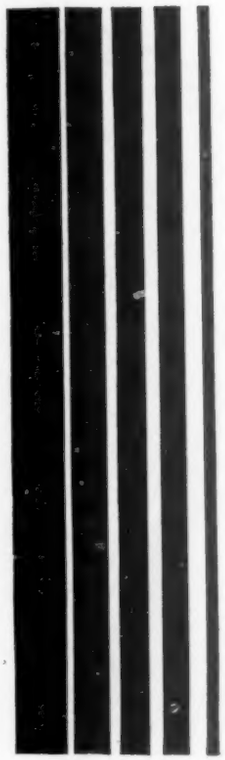
We are ready at all times to assist you in perfecting your welding technique through the use of National Welding Carbon Products. Write us for list of our distributors.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division
Cleveland, Ohio

Unit of Union Carbide UCC *and Carbon Corporation*

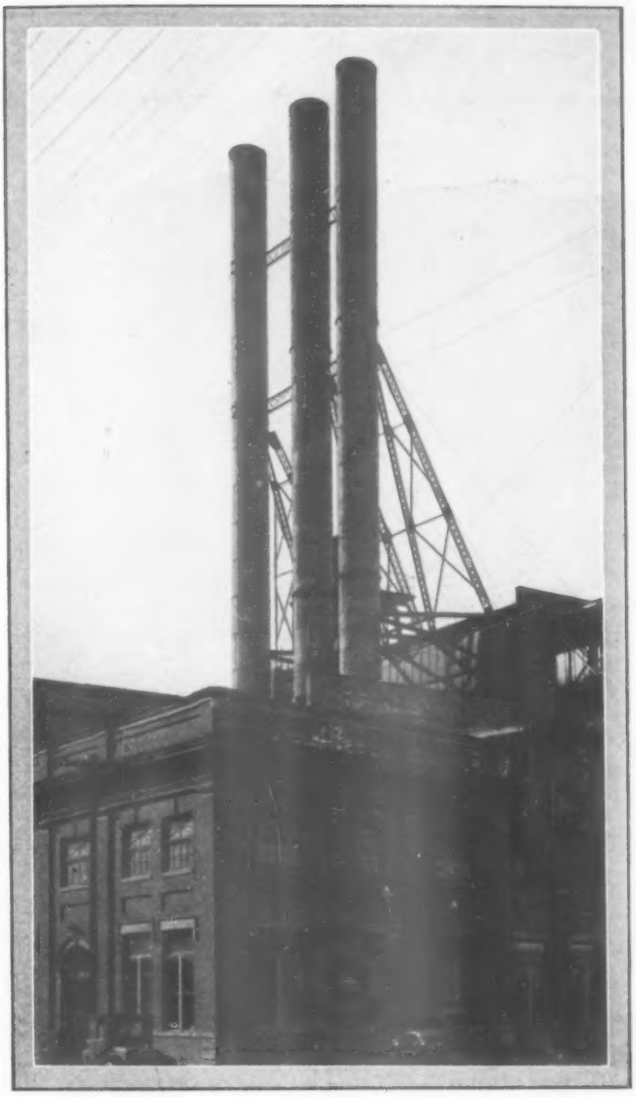
Branch Sales Offices are located in

Jersey City, N. J. Pittsburgh, Pa. Birmingham, Ala.
Chicago, Ill. San Francisco, Cal.



NATIONAL WELDING CARBON PRODUCTS

BLOCKS
RODS
PASTE
FLOUR
ELECTRODES



The United Welding Company chose ARMCO Ingot Iron plates for two new all-welded stacks installed at the Hooven-Owens-Rentschler Company, Hamilton, Ohio. They found pure iron's ductility and weldability decided advantages in forming and assembling these huge stacks, the two shown in the foreground.

You save · · · and customers save *with* PURE IRON

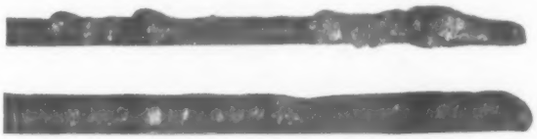
WHETHER it's a tank, stack, pipe or other plate equipment, pure iron cuts fabricating costs for you and maintenance costs for your customers.

In the shop you have the superior welding advantages of ARMCO Ingot Iron. Plates work easily, hot or cold. Welds are dense, strong, and as rust-resistant as the parts joined.

These advantages come from uniform and consistent purity. ARMCO Ingot Iron is highly refined. Impurities that cause irregularities in welding operations, and hasten rust in the finished product, are practically removed by special purifying processes.

The office nearest you will gladly discuss with you the advantages of ARMCO Ingot Iron plates, welding rods, and electrodes. There is no obligation.

Why pure iron rods and electrodes assure sound dense welds



Result of flame test applied to ordinary welding rods.

The same test as conducted with ARMCO Ingot Iron.

THE AMERICAN ROLLING MILL CO.
Executive Offices: **Middletown, Ohio**
Export: **The Armco International Corporation**
Cable Address: **ARMCO, Middletown (O)**

DISTRICT OFFICES

Chicago	Detroit	Pittsburgh
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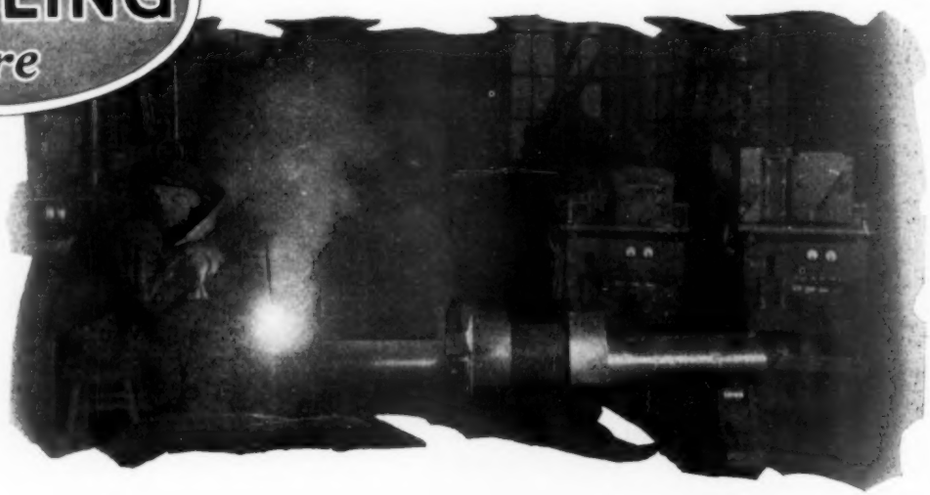
ARMCO INGOT IRON RESISTS RUST

Welding
ROEBLING
Wire



Makes Strong Welds

Strong Welds are made only when the best electrodes are used. Roebling Welding Wire is manufactured to meet the most rigid specifications. It is uniform in quality throughout each shipment and throughout all shipments. Look for the JAR trademark stamped on each electrode.

Catalog A-529

John A. Roebling's Sons Company

Trenton, New Jersey

Conquer abrasive wear with Haynes Stellite

ALL friction develops heat—heat sufficient to soften even the best steels and reduce their resistance to abrasive wear.

Haynes Stellite is inherently hard. It retains its hardness at temperatures up to 1800°F. Steel softens long before this temperature is reached. This unique property of red hardness makes Haynes Stellite especially adaptable on parts subjected to extreme abrasive wear. It outlasts the best steels three to five times.

Whether it is an ounce of Haynes Stellite on the surface of a cam—or a pound on an oil well drilling tool—or as much as 100 pounds on the wearing faces of a brand new piece of equipment—regardless of the amount, Haynes Stellite pays for itself many times over in reduced maintenance costs and increased production.

Many manufacturers now supply Stellited parts for replacements. Your own welding department can also apply Haynes Stellite. Haynes Stellite booklets describe the process—sales representatives will show you how.

HAYNES STELLITE

—is an intrinsically hard cast metal.
—requires no heat treatment.
—has temper that is inherent and permanent.
—is not affected by heat up to 1800° F.
—is tougher at red heat than when it is cold.
—resists abrasion better than any other metal.
—is highly resistant to almost all acids and chemical compounds.
—has the untarnishable qualities of gold and platinum.
—takes a high silver-white polish and retains it.
—is non-magnetic and does not adhere to other metals.

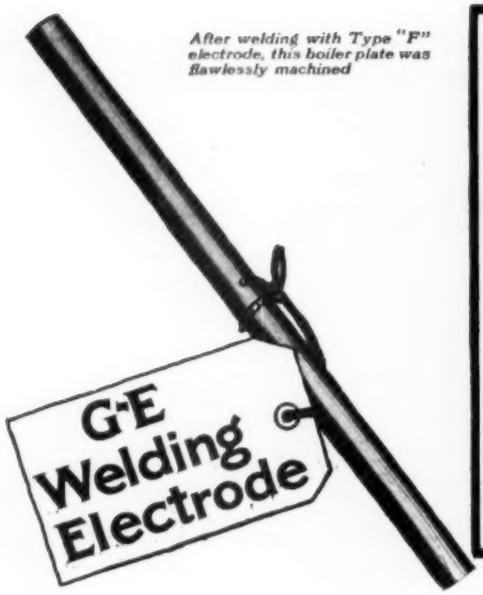
Stelliting with HAYNES STELLITE

HAYNES STELLITE COMPANY
Unit of Union Carbide and Carbon Corporation

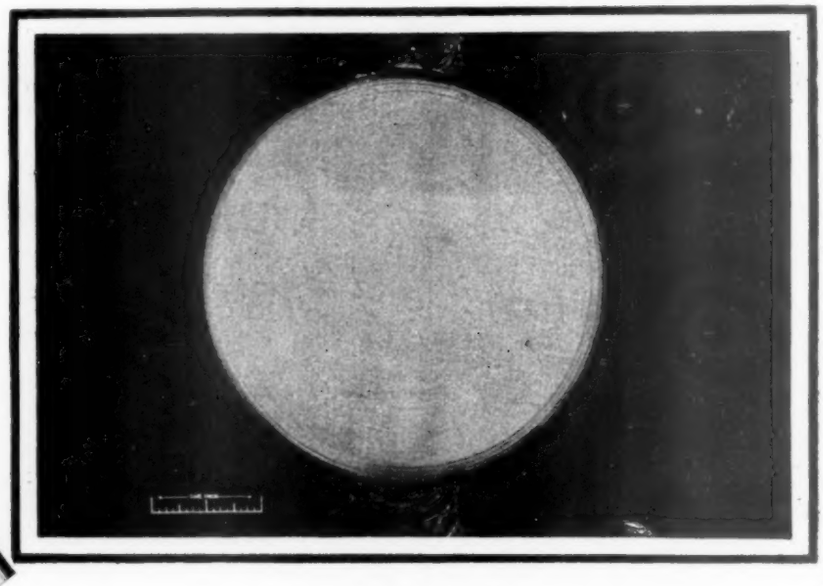
UCC

DISTRICT SALES OFFICES
Chicago—1949 Peoples Gas Bldg.
Cleveland—628 Keith Building
Detroit—4-240 Gen'l Motors Bldg.
Houston—6119 Harrisburg Blvd.
Los Angeles—1310 Santee Street
New York—30 East 42nd Street
San Francisco—114 Sansome St.
Tulsa—Exchange Nat. Bank Bldg.
General Offices—Kokomo, Indiana

Haynes Stellite welding rod is also available from any of the 28 District Sales Offices of Oxweld Acetylene Company.



After welding with Type "F" electrode, this boiler plate was flawlessly machined



—for machinability

Perhaps 60 per cent of the industrial welding to-day does not require machining or finishing. However, for welds which must be finished, it is essential that the electrode be evenly deposited, absolutely clean, easily and accurately machined.

It is this machinability, coupled with every other desirable electrode characteristic, which makes G-E Type "F" preëminent among welding electrodes. The average machine tool cuts it away in a long, even curl. It neither chips nor flakes. In addition to its machining qualities, Type "F" unfailingly maintains its reputation for tough, lasting welds, easily produced.

For prompt service or additional information as to various types of G-E electrodes, get in touch with the G-E Welding Electrode Distributor near you or write to Section E-532, Merchandise Department, General Electric Company, Bridgeport, Connecticut.

In absolute reliability of operation and over-all efficiency, G-E arc welders are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

550-500

GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT CONNECTICUT

3 remarkable machines for hand welding

WD-200A

WD-300A

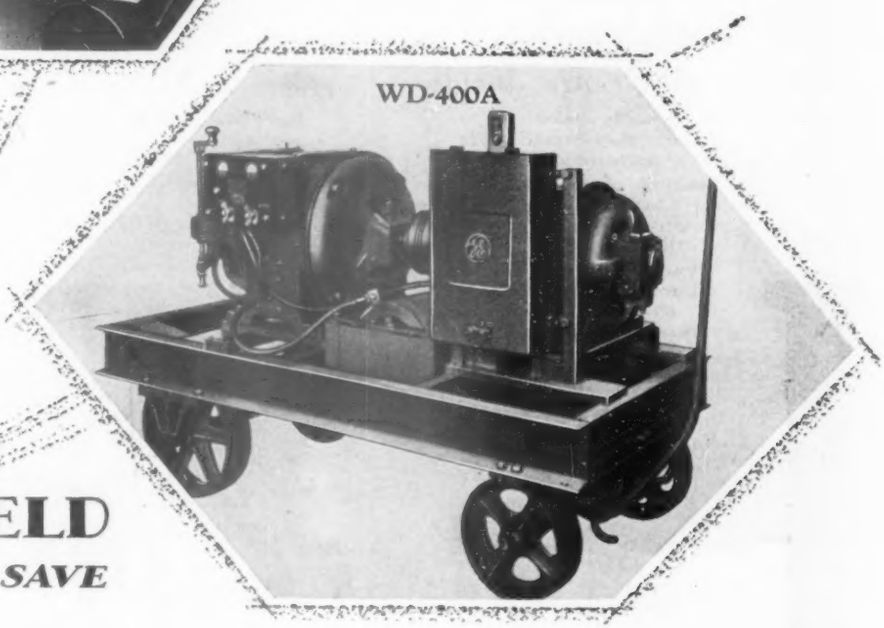
General Electric presents a new line of Type WD arc welders with all the good features of the old line plus new features which permit an ease of welding never before obtainable from any welders.

Your operators will like them because they have loads of pep for fast, high-grade welding. Because they hold the arc with remarkable steadiness. Because they permit an infinite number of current gradations by the simple turning of a handle.

You'll like them because they are the most substantial sets built. Because they are simple—no exciters or rheostats to require maintenance. Because they meet the standards of the National Electrical Manufacturers Association.

Ask your nearest G-E office to send you descriptive literature.

WD-400A



THE MORE YOU ARC WELD THE MORE YOU SAVE

530-42

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Pop learns where to get the right answer—promptly.

"Here, Lad—

I wish you'd go up to the service station and find out whether my auto has been fixed up — I've called them up a half dozen times and can't get any satisfaction. The place is so big that I don't seem to be able to find anyone in authority."

"Sure, Pop—

but before I go and while that's hot in your mind let me say that it bears on the reason why I asked you to deal with Lincoln Electric Company on those welders we're thinking of buying.

When you call up or write them, your request falls smack into the hands of an executive who can *on his own authority* answer it.

The organization is just the right size to find the man you want without giving your life's secrets to the information clerk.

Whether your request is for prices, information, engineering, policy or what not, the request comes to the man whose say is final.

In other words, you get a square shot as opposed to a merry-go-round in the vicious circle."

The Lincoln "Stable-Arc" Welder

— welds easier
— makes better welds
— permits greater output

because of the steady uniform arc throughout entire welding range, which is the result of:

Variable voltage design
Laminated magnetic circuit
Separately-excited generator field
Double control of welding heat
All steel construction

No other welder has all these features.

The Lincoln Electric Co.
Dept. No. 27-1, Cleveland, O.

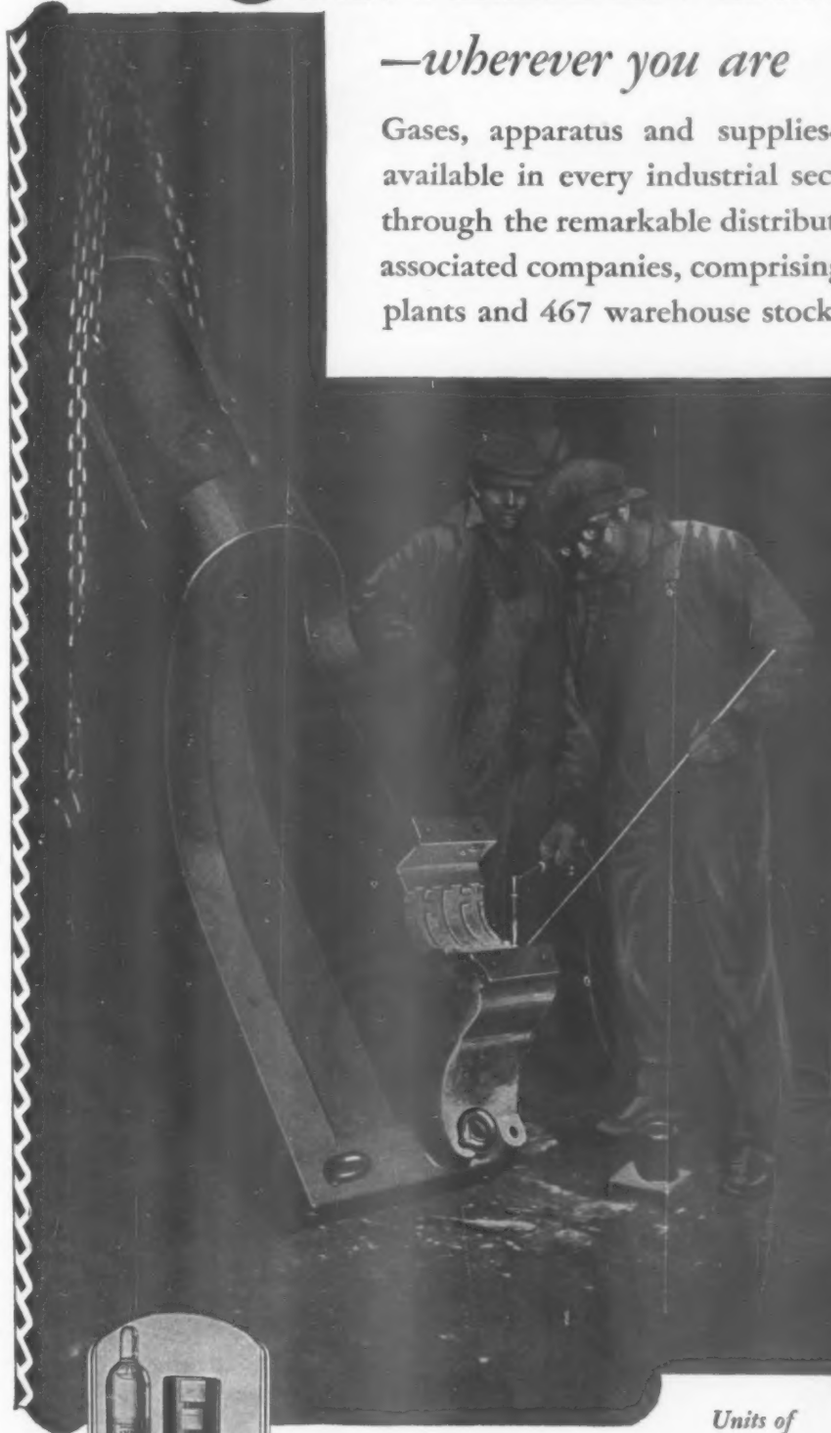
W-68

"Stable-Arc" LINCOLN WELDER

Everything for OXWELDING *and* CUTTING

—wherever you are

Gases, apparatus and supplies—are immediately available in every industrial section of the country through the remarkable distribution system of these associated companies, comprising 93 manufacturing plants and 467 warehouse stocks.



The Linde Air Products Co.
LINDE OXYGEN

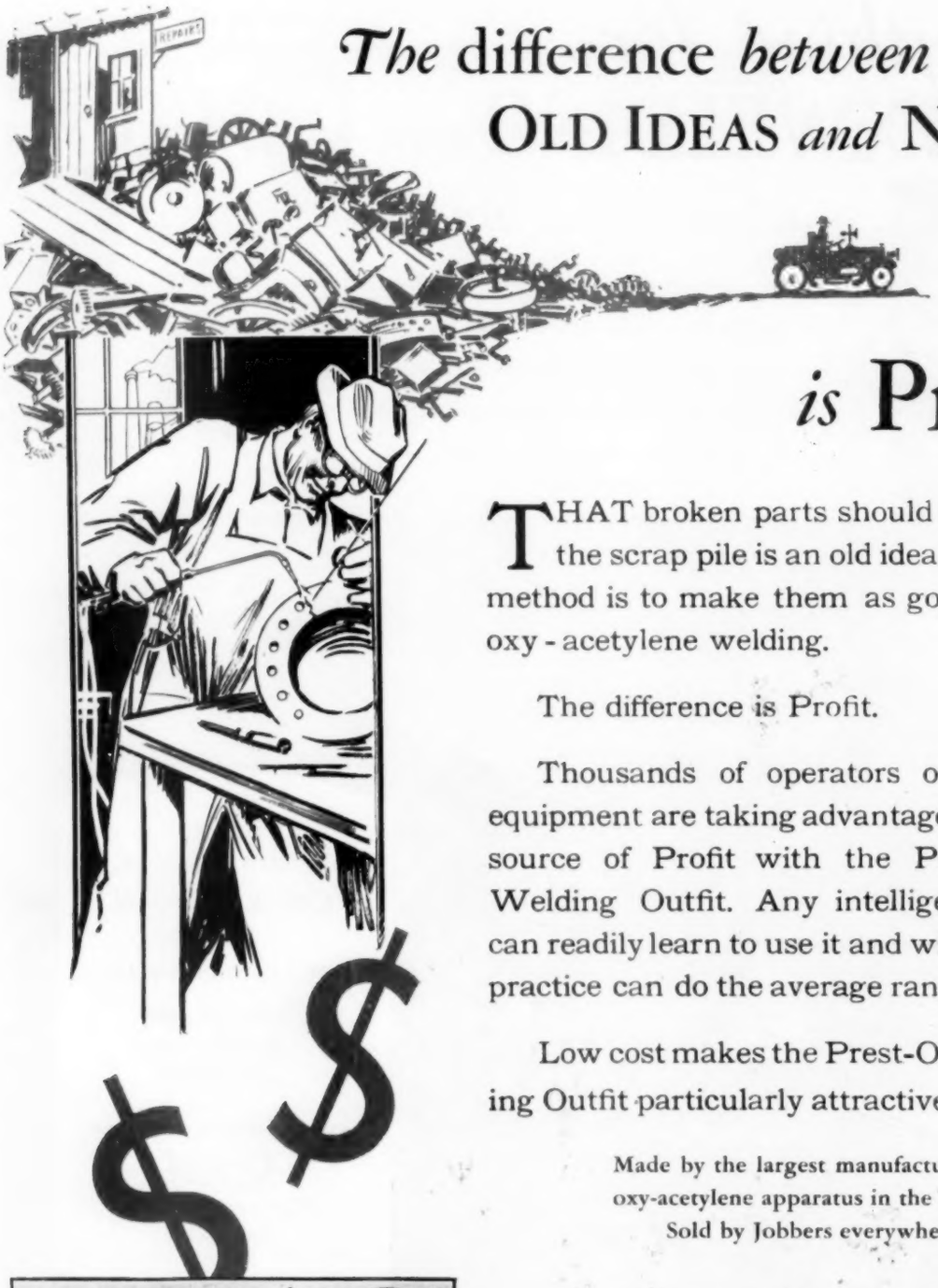
The Prest-O-Lite Co., Inc.
Prest-O-Lite
Dissolved Acetylene

Oxweld Acetylene Company
Oxweld
Apparatus and Supplies

Union Carbide Sales Co.
UNION CARBIDE

Units of
UNION CARBIDE AND CARBON CORPORATION

General Offices UCC *Sales Offices*
30 East 42nd Street, New York, N.Y. In principal cities of the country



The difference *between* OLD IDEAS *and* NEW . . . *is* Profit!

THAT broken parts should be thrown on the scrap pile is an old idea. The modern method is to make them as good as new by oxy-acetylene welding.

The difference is Profit.

Thousands of operators of mechanical equipment are taking advantage of this added source of Profit with the Prest-O-Weld Welding Outfit. Any intelligent workman can readily learn to use it and with reasonable practice can do the average range of welding.

Low cost makes the Prest-O-Weld Welding Outfit particularly attractive.

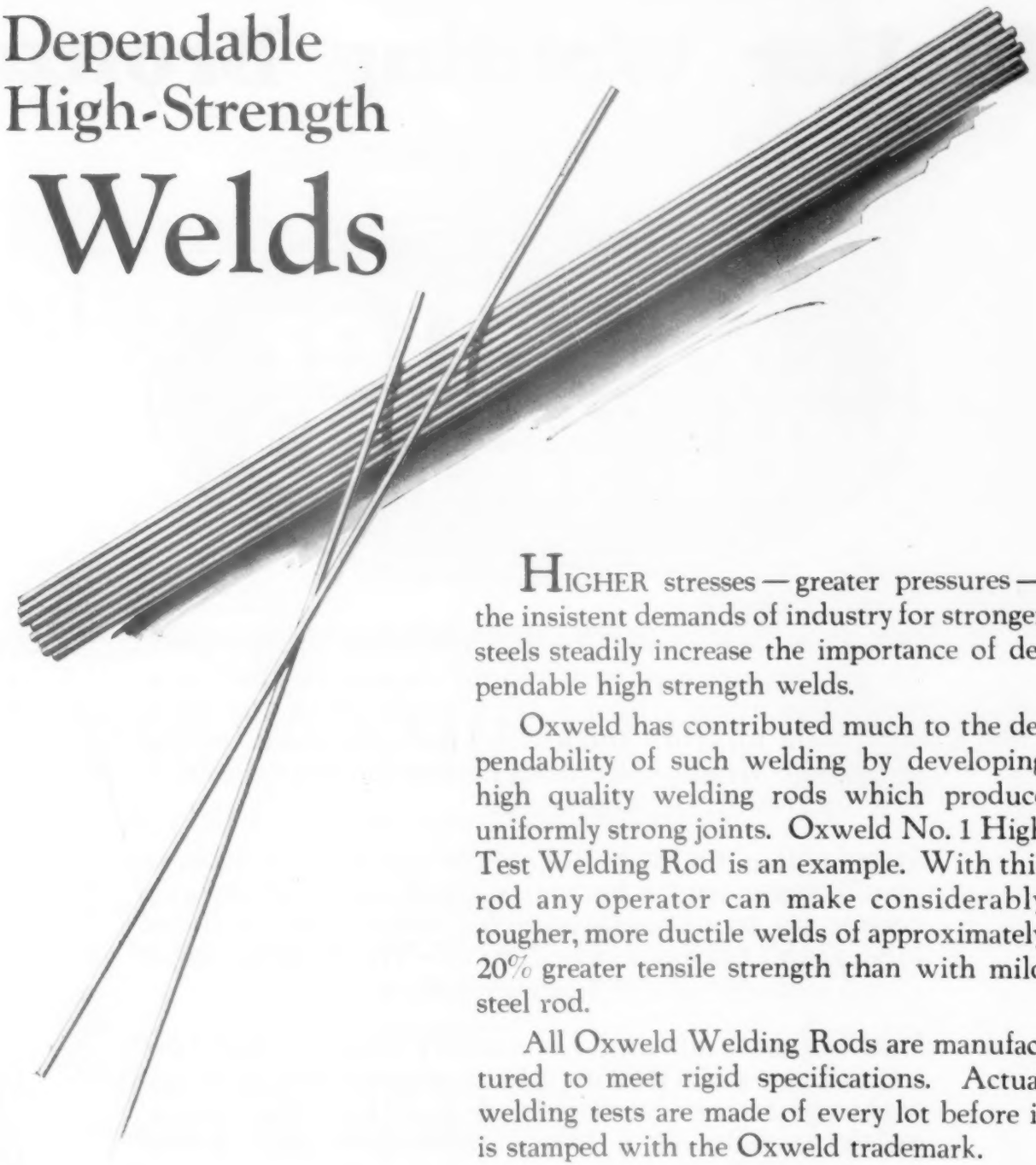
PREST-O-WELD
Welding Outfit No. W-101
Price $75.00
Other utility outfits as low as $49.50

Made by the largest manufacturers of oxy-acetylene apparatus in the World.
Sold by Jobbers everywhere.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
NEW YORK: Carbide and Carbon Bldg.
CHICAGO: Peoples Gas Building
SAN FRANCISCO: Adam Grant Building

PREST-O-WELD

Dependable High-Strength Welds



HIGHER stresses — greater pressures — the insistent demands of industry for stronger steels steadily increase the importance of dependable high strength welds.

Oxweld has contributed much to the dependability of such welding by developing high quality welding rods which produce uniformly strong joints. Oxweld No. 1 High Test Welding Rod is an example. With this rod any operator can make considerably tougher, more ductile welds of approximately 20% greater tensile strength than with mild steel rod.

All Oxweld Welding Rods are manufactured to meet rigid specifications. Actual welding tests are made of every lot before it is stamped with the Oxweld trademark.

OXWELD

WELDING AND CUTTING APPARATUS AND SUPPLIES

OXWELD ACETYLENE COMPANY

Unit of Union Carbide and Carbon Corporation

NEW YORK, 30 E. 42d St. UCC CHICAGO, Peoples Gas Bldg.

SAN FRANCISCO, Adam Grant Building

IN CANADA, Dominion Oxygen Company, Toronto

STOCKS IN 38 CITIES

You'll Get Better Results With Mueller Welding Bronze

Give it any test you choose

YOU will find in Mueller Welding Bronze Rod all the qualities you would expect to find in a first class quality bronze. It is made from our own particular mixture and always distinguished by the wording "Mueller Welding Bronze" stamped every few inches on the rod itself.

Standardize on Mueller Welding Bronze Rod—you'll never find a better one and one that always comes up to expectations for either big or little jobs. Don't take our word for it—We'll gladly send you a sample. Try it for yourself.

Mueller methods and Laboratory control and the experience gained from "three generations of brass making" insure a finished product that fuses quickly, melts at a low temperature and flows evenly and freely.

When you are in a hurry you can count on quick delivery, too.

Mueller Brass Co.
PORT HURON MICHIGAN

THREE GENERATIONS OF BRASS MAKING

Everybody's Neighbor

230 UNION CARBIDE warehouses situated in important trade centers throughout the country are at your service. An adequate stock is always on hand at every unit in this nation-wide distributing system. Large shipments are constantly enroute from Carbide Plants to these warehouses.

This enables *you* to get Union Carbide deliveries when you want them.

Union Carbide is shipped the day order is received.

UNION CARBIDE SALES COMPANY

Unit of Union Carbide and Carbon Corporation

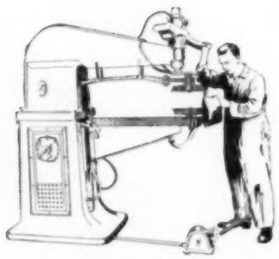
UCC

New York	Chicago	San Francisco
Carbide and Carbon Bldg.	Peoples Gas Bldg.	Adam Grant Bldg.

No matter what kind of welding you do--

OXY-ACETYLENE

ELECTRIC ARC



RESISTANCE

THERMIT

YOU NEED

The Welding Encyclopedia

New Sixth Edition

It describes in detail the theory and practice of every welding process.

It tells how to weld every weldable metal by each of the welding processes.

It gives detailed instructions for handling the important welding jobs, such as boiler welding, sheet metal welding, tank welding, pipe welding, etc.

It tells how to prepare parts for welding.

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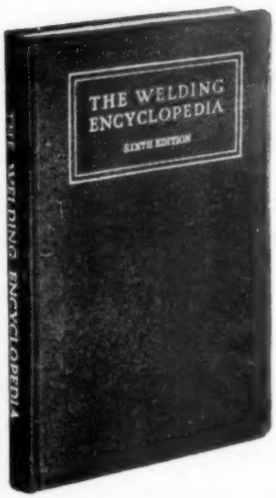

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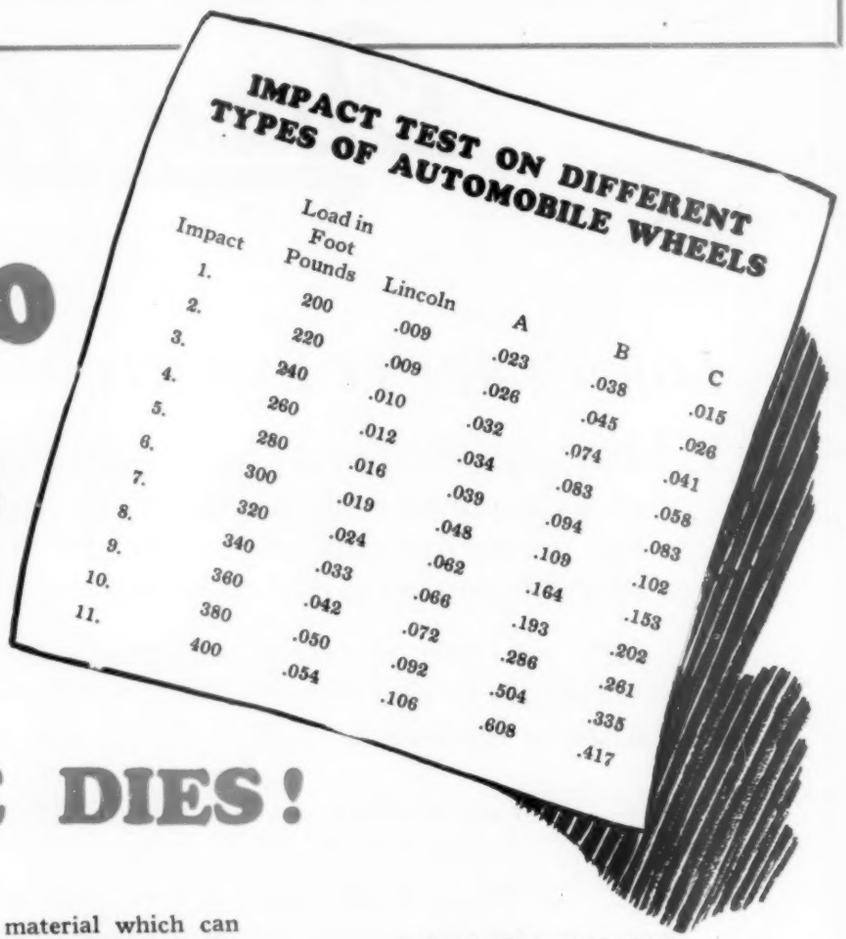

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Secondary Amperes	12,000
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EDITORIAL

Welding in 1929

NO presidential campaign has ever presented such an opportunity for direct appeal to the masses as the one through which we have recently passed. It will never be known how many millions of voters heard all the speeches made during the fall. An important topic was business and personal prosperity. Both sides promised it. And the stock market ran riot before, during, and after the election. Now the country is stretching its neck to see what changes, if any, will be brought about in the next administrative period. What lines of business will prosper? Will stocks continue to rise? How many suckers will lose their shirts if they fall? The good-guessers will answer such questions correctly and the poor guessers will blame everything on the administration. As for our next President, the business press has great confidence in the ability and integrity of Mr. Hoover. It is a matter of mutual understanding, for Mr. Hoover has had opportunities in the past to show his understanding of the problems and possibilities of business papers, and they in turn have profited from their contacts with him and his work. In general, therefore, the outlook is favorable. More specifically we should keep in mind the importance of all forms of welding in steel fabrication. Most authorities predict a high production of steel as far in the future as they can logically expect to account for. If welding had reached its full development this would be a happy outlook. But if development work continues as it should the volume of welding will increase, even in the face of a decreased steel production later in the year. The industry has not developed the markets represented by structural steel fabrication, machine construction, and industrial piping. It has only proven its value. Meanwhile the process has not been displaced in fields where its development may be considered as accomplished. 1929 will see more welding.

A New Service for Business Men

THE Conference of Statisticians in Industry, working under the auspices and with the cooperation of the National Industrial Conference Board, 247 Park Avenue, New York City, is composed of a group of statisticians and economists of industrial and trade organizations and leading industrial corporations representing at present about thirty of the leading industries of the country, together with railroad transportation, building construction and important branches of wholesale and retail distribution. It was established during the past year for the purpose of extending and improving the statistical analysis and interpretation of current business conditions through the trade organizations of the country and of providing industry and trade with more prompt and authoritative knowledge of the current business situation based upon careful study of available business statistics and their evaluation in the light of the practical experience of industry itself. In this way the Conference of Statisticians in Industry is designed to provide a systematic and organized expression of current business conditions from within industry and trade, to check and complete the reports and interpretations of the business situation from official and financial sources.

The net impression which the available statistical records and trade reports give for the year 1928 as a whole according to the first monthly statement of this body, is of a year of industrial and commercial activity slightly higher than in the preceding year but little if any above the normal annual rate of expansion of general business except for a few months in the last half of the year. The automobile and building industries have continued to be the leading factors in the business movement, and the extraordinary expansion of stock exchange activity during the year, as in the preceding years since 1923, stands in strong contrast to the general growth of industry and trade. The establishment of this procedure for furnishing more prompt and adequate information on business conditions is a welcome bit of economic cooperation.

A "Welding Minded" Community

THE fact that a community can be educated to the full possibilities of welding is made evident by the present situation in a small Ohio village of about one thousand population. The welding equipment salesman entering that town for the first time would be amazed at the number of welding shops and the amount of good equipment which they contain. By actual count there are seven acetylene generators of various sizes in operation and about ten sets of equipment containing both welding and cutting torches and the necessary regulators. All these supplies of the welding trade are in use in four welding shops of various sizes and doing somewhat different types of work. Two of them are just auto repair shops with single outfits in each. Another is an ordinary welding shop, but well equipped with a large generator and a portable for outside jobs, with the outfits of torches and regulators to go with them. The fourth place is a good sized welding and machine shop with two large stationary generators and a portable along with equipment for at least four welders. These places are all doing a fair amount of business and have been in operation for a number of years, the largest for about twenty years. In a somewhat larger village just seven miles north there is only one welding shop. In a town of 2,000 population a little further on there are two small welding shops. And at the county seat, a town of 3,000, there are only four small welding places, none of which compare at all favorably with those in the first mentioned village. After a survey of this situation one wonders why it is that this small village supports four well equipped welding shops and these other larger towns in the same type of community obviously do not. The answer seems to lie in the fact that the population of the first village has become educated to an understanding of the possibilities of welding and make use of this knowledge, whereas the residents of these other larger towns have not as yet any conception of the possible uses of the service offered by a good welding concern. Then the question arises, "How did the people of this village become educated to the possibilities of the welding process?" Here one can easily see that it was just through the wide-awake application of this process to all types of metal repair work with each job done well for a number of years. This type of service induced a favorable sentiment toward welding in this small community, and served as a continual advertisement of the process. In other words, to increase the use of the welding process in any given community it is first necessary to have good, ingenious and continuous service by some well-equipped welding concern. And in towns larger than the village mentioned it becomes necessary to advertise, as the welder cannot have an acquaintanceship with all of his possible prospects. In such cases a little calendar, or a daily memo pad, or some such reminder is a great aid in keeping the name before the prospect, but some form of advertising is essential if the business is to really prosper.

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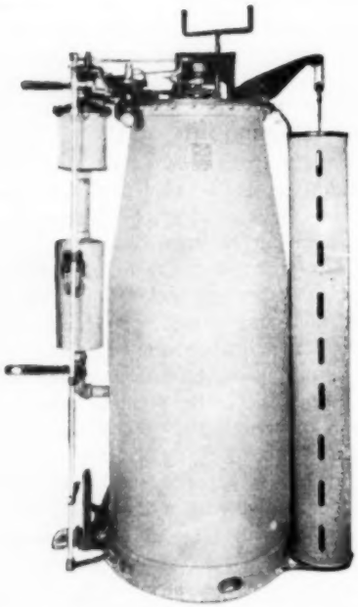

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Welding Aluminum Tanks for Airplanes

Materials—Welding Fluxes—Heat Source—Stiffening—Bulkheads and Baffles—Supports—Annealing—Types of Welds—Cleaning After Welding

By J. F. Hardecker*

ONE of the outstanding features of the aeronautical power plant is the use of aluminum and aluminum alloy for fuel, oil and water tank construction. Due to the lightness of these metals, they have been extremely desirable from the start, and the development of welding has made practical the construction of tanks from these materials for aircraft use. The practices developed for tank construction also find application in cowling

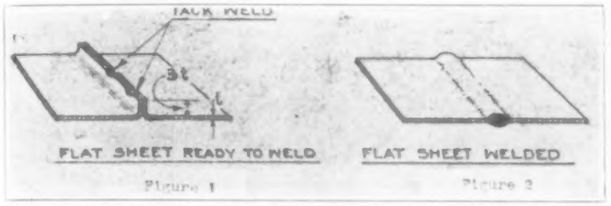


Figure 1 Figure 2

constructions, repair work and other non-structural uses in aircraft, and may well find their counterpart in other industries.

Welded Aluminum Tanks:

The aluminum tank, up to the present, is by far the commoner and it will be considered first. The best material for this purpose is half hard sheet aluminum (99% pure), except where maximum ductility is required in fabrication, as in spinning, deep drawing, etc., when soft aluminum (99% pure) may be used. The thickness of sheet used in the construction of any tank will depend upon the size, shape, purpose, exposure to accidental damage, presence of baffles for stiffening, etc., and is generally

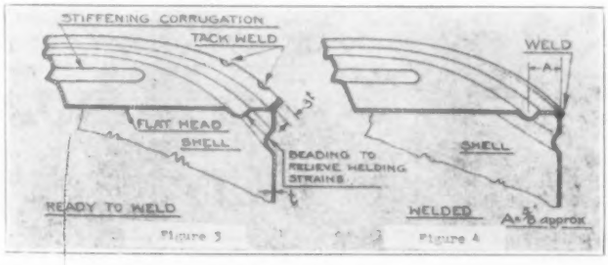


Figure 3 Figure 4

one of the following gages No. 14 B&S (.064), No. 16 B&S (.051), No. 18 B&S (.040) and No. 20 B&S (.032). Gages No. 16 and No. 18 will be found best for most cases. Welding wire should be of the same chemical analysis as the sheet aluminum, and may be made of strips sheared from the same sheets of which the shell is constructed.

Fittings may be made of 99% pure aluminum sheet, tube or bar or forgings or of aluminum alloy castings (SAE Standard Alloy Spec. No. 30.) In castings, due to the fact that this alloy is not suitable for die casting, all fittings should be sand cast, chills being used only in spots. Patterns for sand casting must have all corners well filleted and where possible holes should be cored rather than cast solid and drilled, in order that sections may be as uniform as possible in order to avoid porosity from uneven shrinkage.

*Chief Draftsman, Naval Aircraft Factory, Philadelphia, Pa.

Cleaning Before Welding:

Edges and surfaces to be welded may be cleaned by immersion from 10 to 30 seconds in a hot solution of caustic soda trisodium phosphate or the equivalent, followed by rinsing in

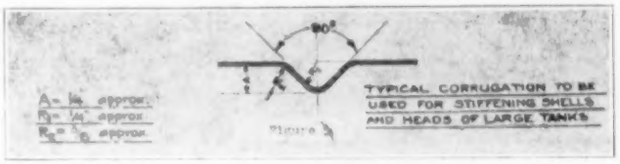


Figure 5

dilute (10%) nitric acid and finally in clean hot water. This corresponds to a pickling treatment for steel. Immersion must not be longer than is necessary to clean the surface, as the metal is rapidly attacked. If the aluminum is originally smooth and bright and free from grease, cleaning with a wire brush or steel wool is often satisfactory in place of the foregoing treatment.

Welding Flux:

There are many forms of welding flux used for aluminum,

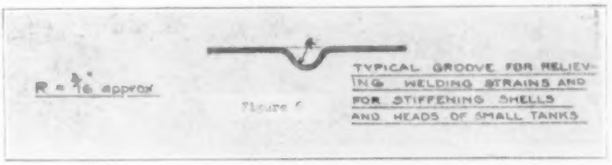


Figure 6

with advantages claimed for each formula by its proponents. A good flux is sodium chloride 6.5%, sodium sulphate 4%, lithium chloride 23.5%, potassium chloride 56%, aluminum sodium flouride (cryolite) 10%. The welding powder should not be needlessly economized as it results in an even, attractive and light flux which is essential to good results. The welding powder can be used both in the form of powder and of a thin

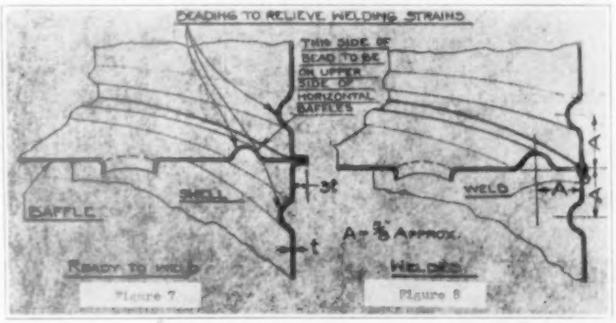


Figure 7 Figure 8

paste (mixed with distilled water). For thin sheet metal work, which is prevalent in tanks, the paste is to be used, the powder being restricted to heavy sheet or the welding of castings. The paste should only be made up as used, as it deteriorates and becomes useless in time in this form.

Aluminum welding flux is highly hygroscopic, that is, it attracts dampness. It therefore rapidly attracts dampness in the

air, and thus gradually loses its characteristic properties. In order to prevent this, the powder is stored in glass bottles fitted with ground corks. The heated end of the wire should never be stuck in the bottle; but only as much powder as is needed for the work in hand should be taken out and placed in a small saucer.

Heat Source:

Many forms of electric welding have been developed, but they are all chiefly in the laboratory or experimental stage with the exception of gas welding. Acetylene and hydrogen are the principal gases used in welding. Hydrogen is used chiefly with thin sheets and acetylene with the heavier sheets. Hydrogen welding gives the greater hardness and lower elongation, due probably to the fact that hydrogen is easily absorbed by liquid aluminum.

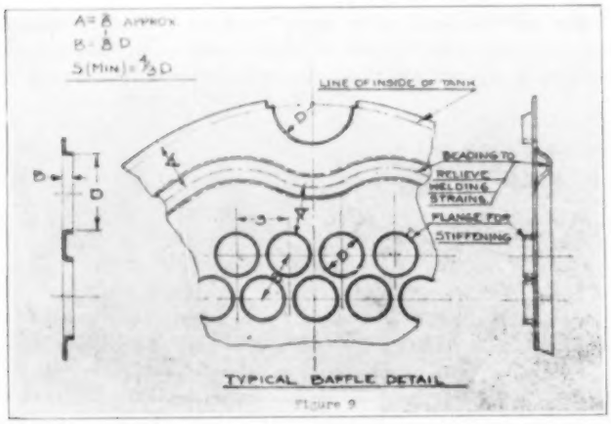


Figure 9

The transition from solid to liquid state occurs suddenly with aluminum, without any preliminary signs of its being evident. So it is the job of the welder to watch out for the moment when the material begins to melt and then begin the fusion of the added material in good time. If this is overlooked, then especially in thin metals, there is the danger of burning a hole.

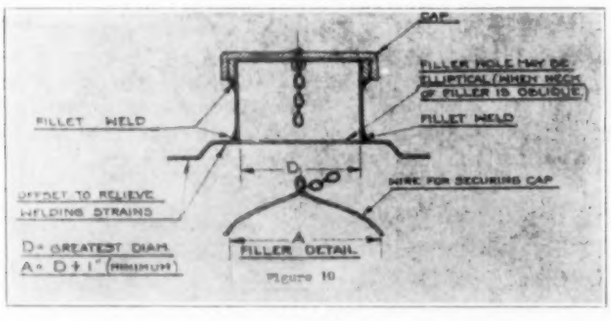


Figure 10

In spite of the great difference in temperature between the low melting point of the aluminum and the high combustion heat of the flames, the flux only begins to melt after a comparatively long period which is a result of the great heat conductivity of the aluminum. The size of the welding flame must be in proportion to the thickness of the material; too strong a flame and too small a flame are alike detrimental.

Thermal Expansion:

Ample provision for thermal expansion and contraction must be made around all welds by means of beads or crowns found in the sheet metal as shown by Figures 3, 4, 7, 8, and 10, respectively, unless free expansion has been otherwise provided for. All beads, bends, shoulders, etc., must be smooth and well rounded, sharp corners being avoided. In small dished heads the beading adjacent to the weld may sometimes be safely omitted, but the cylinderical shell should be beaded.

Stiffening:

Large flat surfaces should be avoided; but where unavoidable must be stiffened by corrugations or baffles (see Figures 3, 4, 5, 6, 7, and 8). Flat surfaces may be used where they have external support, as in tank bottoms resting on a platform of sufficient strength to support the load. Dished heads are preferable and do not require stiffening corrugations. Beads may be used for stiffening small flat surfaces and "V" shaped corrugations for larger surfaces, being spaced to suit the design. In heads and shells, stiffeners should project inward, leaving the outer surface flush. Cylinderical tank shells, if large, should have stiffening corrugations at intervals.

Bulkheads and Baffles:

Bulkheads or baffles should be used in tanks where necessary for stiffening and for preventing undue motion (swashing) of the contents. They should be fastened to the shell by torch welding as shown by Figures 7 and 8. Baffles should have lightening holes with flanged edges for stiffening, with the sizes and spacing to suit the design (see Figure 9). Where flanges are horizontal the flanged edges of the lightening holes must be turned down (see Figures 7 and 8). Where baffles are vertical, holes having a radius equal to the diameter of the lightening

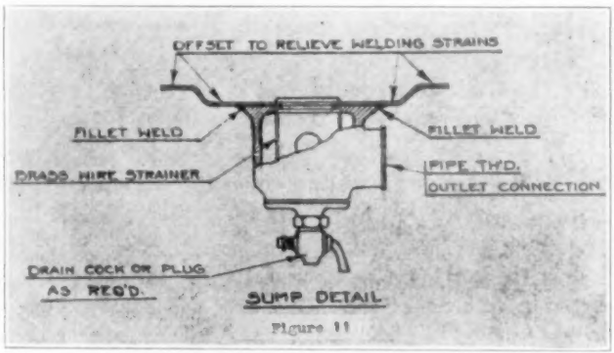


Figure 11

holes must be provided at high and low points to allow for drainage, as shown in Figure 9.

Supports:

Brackets for support must not be attached directly to the tanks. If tanks are flat bottomed they may rest on the floor, otherwise, cradles or suspension slings shall be provided to evenly distribute the load and prevent excessive pressure at any point. Sling are preferably of steel strap or wire, with generous felt padding. The use of leather padding is advised against, as it is likely to contain materials which will induce corrosion. Pipe lines must be amply supported where they join tanks to guard against harmful vibration.

Annealing:

Half hard aluminum sheet, or aluminum sheet which has been hardened by cold working (spinning, forming, deep drawing, etc.), may be annealed, by moving a flame over the surface to be softened until it is just hot enough to cause a piece of paper to leave a brown mark when rubbed against the metal. Annealing may also be done by raising the temperature of the aluminum to 680° F for a period of one minute in a muffle furnace. This may also be accomplished by immersion in a salt bath of 680° F for one minute or less (The salt bath may be composed of equal parts of sodium nitrate and potassium nitrate). Excessive time or temperature in annealing will cause coarsening of the grain which impairs physical properties.

Flange Type Weld:

In joining the edges of sheet, the flange type of weld should be employed. The edges to be joined are bent up or "flanged" an amount equal to about three times the thickness of the sheet, as shown in Fig. I. After cleaning, as previously described, flux is supplied to both sides. The edges are then held together by means of small clamps, and "tack welded" at intervals of

about one inch by melting the metal together at these points, touching up, if necessary with the welding rod. The clamps are then removed. If the flangs have spread apart noticeably, they should be pinched together with a pair of pliers. Flux is again applied, where needed, and the weld is completed by melting down the flanges, holding the torch at an angle of 45° with the work, and in line with the weld and progressing continually at a uniform speed. Little or no metal is added from the welding rod. A sound and smooth bead should be formed, well rounded on both the upper and lower surface, as shown in Figure 2. (See also Figures 3, 4, 7, and 8).

Fillet Type Weld:

Rivets should not be used to fasten parts to the outside of the tanks. In joining fittings or sheet metal parts to the side of sheet, the fillet type of weld is commonly used as shown in Figures 10 and 11. After cleaning and applying flux to the surface to be welded in the usual manner, the parts are tack welded together at intervals by small applications of metal from the welding rod, so as to be held firmly in place, flux being re-applied where needed. The weld is then made by melting on filler rod, fusing well with both sides of the joint, so as to insure a sound union. Care should be exercised to avoid burning through the sheet.

Cleaning After Welding:

All traces of flux must be removed promptly after welding. Incomplete removal of the flux will cause corrosion of tanks and fuel lines, and stoppage of strainers, valves, carburetors, etc. Where the work is accessible, as on the outside of tanks, welding flux may be removed by means of a scrubbing brush and hot water, followed by thoroughly rinsing in running water. This treatment is satisfactory only for surfaces which can be scrubbed, as hot water dissolves the flux slowly and requires mechanical action or long treatment to insure removal. Long treatment stains the aluminum.

Inaccessible surfaces may be satisfactorily cleaned of flux by treatment with a dilute solution (about 10%) of either sulphuric or nitric acid, in the following manner. Tanks are completely filled with the 10% solution of either acid and allowed to stand for half an hour, followed by thorough rinsing with fresh water, to remove all traces of acid. The acid should be renewed after approximately ten treatments. After emptying out the acid, the tanks are rinsed by leading fresh water to the bottom by means of a hose or tube inserted through the filler hole at the top, and allowing the water to circulate upward and overflow out of the tank for about an hour. A stoneware tank or a wooden one lined with lead or asphaltum paint, may be used to contain the acid. Complete filling of tanks with the acid bath, and the absence of other metals are essential to avoid pitting.

Final Cleaning:

After final inspection for leaks, tanks may be cleaned by a quick wash (10 to 30 seconds) in a hot solution of caustic soda, tri-sodium phosphate, or oakite. This must be followed by thorough rinsing in running water to remove all traces of the solution. If a dark brown stain is left by any alkaline solution, it can be removed by rinsing in dilute nitric acid, and finally water. The tanks should now have a clean bright (but slightly etched) surface, and are ready for the application of varnish or enamel. The inside of tanks may be further protected against corrosion by treatment with sodium silicate solution at a temperature of 150° F for one hour.

Welded Aluminum Alloy (Duralumin) Tanks:

Duralumin tanks, due to the greater strength of the material for what is essentially the same weight, or the same strength for a lesser weight, are highly desirable. However, due to the far greater difficulties of successful duralumin welding, it has not been highly regarded as a production proposition. The greatest difficulty lies in the effect of the heat on the material adjacent to the weld. The practice in welding duralumin closely parallels that for aluminum, except that a smaller torch, for better heat concentration, is advisable.

Fittings of any magnitude or number are best attached by first welding to an independent disc, the disc in turn being welded into place. A more generous use of large beads, grooves, crowns, etc., than used in aluminum tank construction is advisable. Simplicity of welds, accessibilty, minimized weld intersections, and the use of sheet or tube in preference to castings, all will help to assure success. A neutral flame, avoiding an excess of oxygen, is desirable to avoid the formation of oxides.

On account of the short temperature range between the melting pot and the burning point of the metal, great care must also be exercised. The application of proper heat is a matter of skill and experience, and is attained only after considerable practice. The aluminum alloy tank has great possibilities; but it is not at present a real production proposition. As skill develops and detail design becomes more expert, it should find a proper sphere in aircraft tank construction.

CUTTING MANGANESE BRONZE UNDER WATER

By L. F. Hagglund*

The increased recognition and use accorded under-water cutting is illustrated in several recent operations.

In figure 1 are shown steel sheet piles cut under water, at High Bridge, N. Y., where a new bridge has been erected to replace the older structure. In illustration 2 is shown diver descending for cutting of the steel sheet piling, which had concrete-filled interlocks. View of pier following removal of the temporary cofferdam piling by use of the oxy-electric under-water cutting torch is shown in illustration 3.

The oxy-electric torch has been operated at various depths

Fig. 1. Steel Sheet Piling Cut Under Water With Use of Oxy-Electric Torch.

down to 120 ft. It will cut any metal at any divable depth and can be operated by the average diver. It has been used to cut steel plate, sheet piling, cast steel, cast iron, brass, copper and manganese bronze.

Illustration 4 shows sketch picturing cuts made by oxy-electric torch under water at depth of 20 ft., to balance manganese bronze propeller of steamship Samaria, at New York harbor. The Samaria was scheduled to sail on a nineteen day cruise, but shortly before sailing, and while lying at her pier on the Hudson River, one of the propellers came in contact with a raft. A subsequent inspection disclosed the fact that the ends of two of the four propeller blades had been broken off for a distance of approximately 1 foot down the blade. The resultant loss of weight on these two blades unbalanced the propeller and caused such great vibration while revolving that it seemed necessary to replace this propeller in drydock before the Samaria could sail. Such repair work, however,

**Manager, Under-Water Metal Cutting Corporation.*

would result in considerable loss both in time and money, and in order to avoid delay, an attempt was made to balance the propeller in place.

Divers measured off the distances on each broken blade then marked off the same distance on each opposite blade.

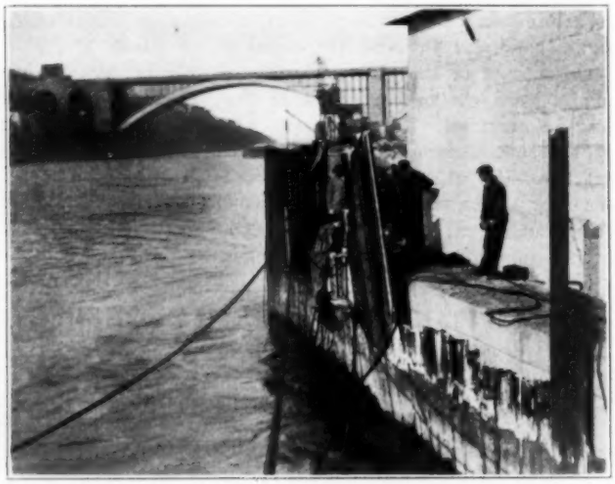


Fig. 2. Scene of Operations at High Bridge, N. Y.

Then, using the oxy-electric torch, the sound blades were cut to conform to the opposite broken blades. The metal cut was manganese bronze. Thickness of the metal varied from ¼

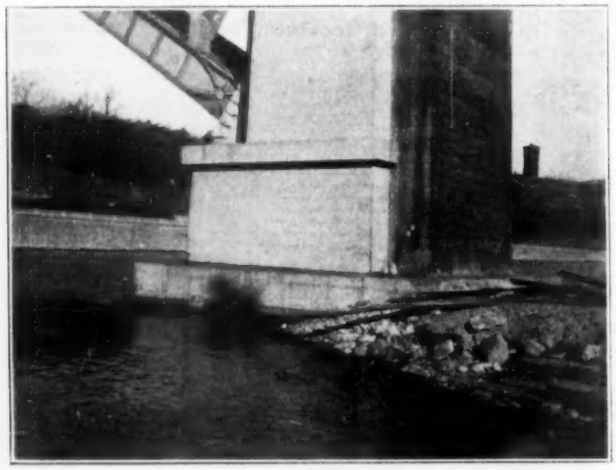
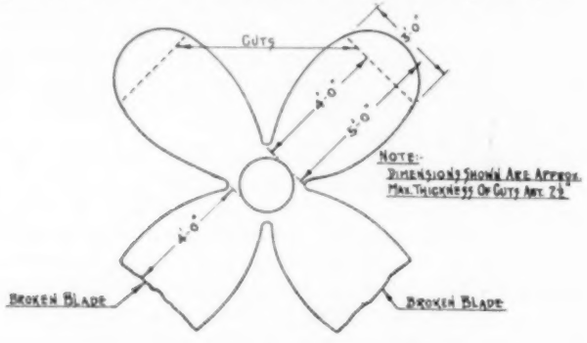


Fig. 3. View of Pier Following Removal of Piling.

to 1¼ in. across the blade. Depth of water was 20 ft. and temperature of the water was freezing. The operation was



SKETCH SHOWING CUTS MADE BY OXY-ELECTRIC TORCH UNDER WATER AT DEPTH OF 20FT TO BALANCE MANGANESE BRONZE PROPELLER

Fig. 4

completed, and the work tested and passed in a little more than a day, and the steamship Samaria sailed on scheduled time.

The accompanying sketch shows the manner in which under-water cutting operators proceeded in their inspection of 48-in. steel pipe under Lake Erie. Manholes were cut 300 ft. apart and the divers operated to a distance of 150 ft.

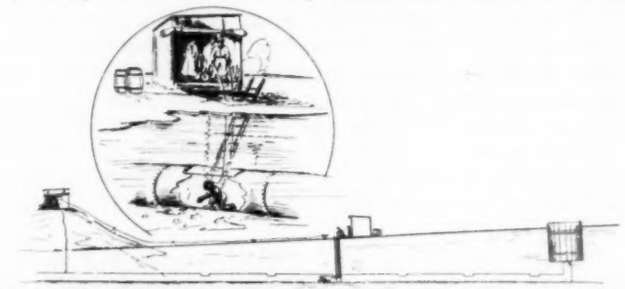


Fig. 5. Illustrating Manner in Which Divers Operated in Work on 48-In. Steel Pipe Under Lake Erie.

each side of each manhole. They were not permitted to go further because of the danger that the air lines might freeze. The power which operated the oxy-electric under-water cut-

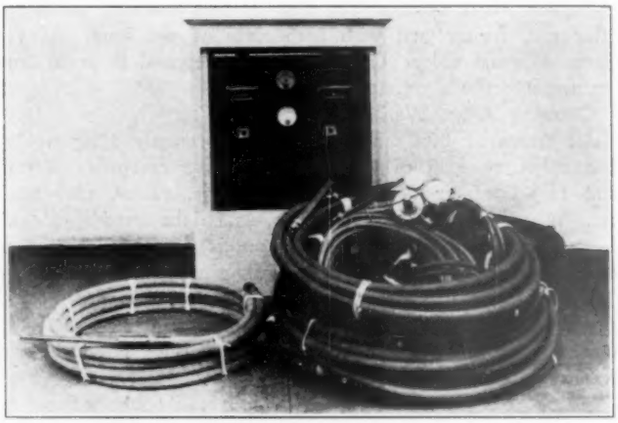


Fig. 6. Underwater Metal Cutting Outfit, as Furnished to United States Navy.

ting torch was supplied by the generator on shore, which is shown at the left in the lower part of the sketch. The depth of the water ranged from 6 ft. near the shore to 25 ft. at the intake pjpes.

"COMING-OF-AGE" OF THE INSTITUTE OF METALS

The Council of the Institute of Metals has found it necessary to alter the date of the 21st Annual General Meeting and "Coming-of-Age" Celebrations of the Institute, from that originally announced (March 6th and 7th) to March 13th and 14th, next.

In addition to a Dinner and Dance at the Trocadero on March 13th an interesting function is being arranged for the second day of the Meeting. This is a Conversazione and Exhibition to be held in the Science Museum, South Kensington, on March 14th. Objects of special interest in relation to the work of the Institute will be displayed; offers of such objects are invited and should be made to the Secretary, Mr. G. Shaw Scott, M.Sc., 36-38 Victoria Street, Westminster, London, S. W. 1.

The Annual May Lecture of the Institute is to be given on May 7th, by Sir Oliver Lodge, F.R.S.

The Annual Autumn Meeting will be held in Düsseldorf next September. Offers of Papers for that Meeting are invited by the Council which, it is understood, will particularly welcome Papers dealing with matters of practical interest. It is proposed also to hold at Düsseldorf a General Discussion on Laboratory Methods of Metallurgical Research, in which speakers from many countries are expected to participate.

Applications for membership are now being submitted so freely, it is stated, that it is expected that the Institute's Membership total will reach the 2,000 mark before December 31st, next.

Cutting Machinery Costs in Half*

An Example of Redesign—A Machine Formerly Made of Castings Is Now Practically a Fabricated Steel Job Throughout

By F. S. Horner

THE purpose of this article is to show the increased economy that can be effected in the production of machines by the use of structural steel shapes joined together by the arc welding process as compared with the commonly accepted

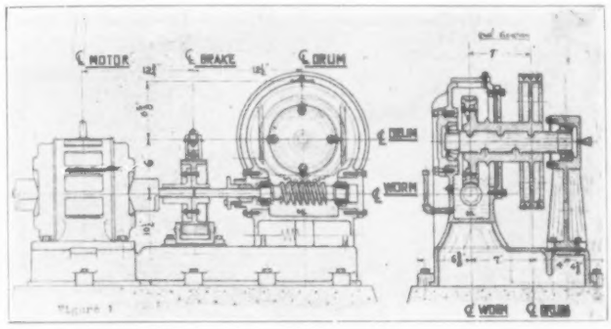


Fig. 1. Sideview Old Style Worm Gear Elevator Engine, Showing Castings Used.

designs using cast iron parts.

The particular machine to be considered is a single worm gear elevator engine of the traction type, wherein practically

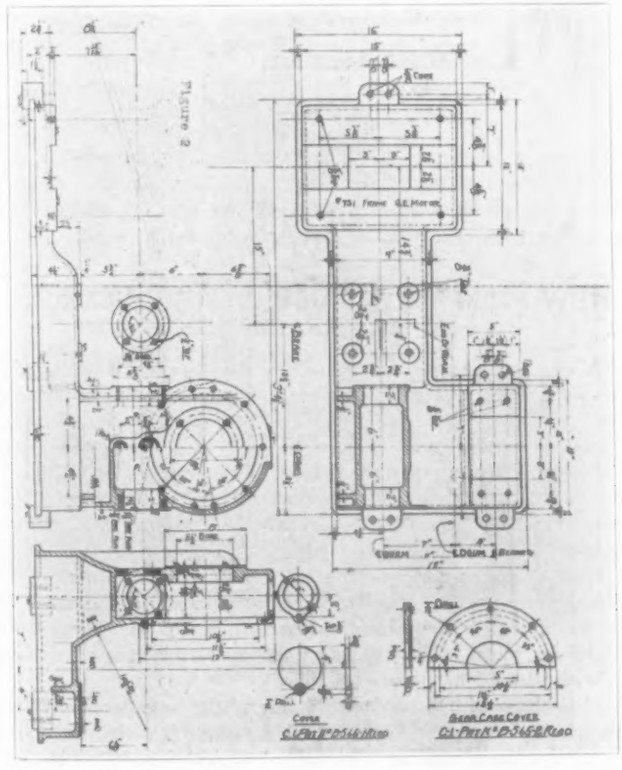


Fig. 2. Further Views of Old Assembly, Showing Various Parts.

present design by standard commercial steel shapes without reducing strength or rigidity of design but resulting in a

*Entered in the Lincoln Prize Essay Contest.

all parts, formerly cast of iron have been replaced in the material decrease in weight.

In order that the reader, who may not be familiar with the general design of such equipment, may fully appreciate the changes from the old to the new design a series of drawings are furnished showing first the old construction assembled and also the individual parts in Figures 1 to 3 inclusive and the new design in Figures 4 to 7 inclusive.

Since the arc-welded steel machine is built up in various units for assembly the various pieces are shown in their relative positions as nearly as possible for ease of description and understanding.

It is the writer's belief that the construction of the machine

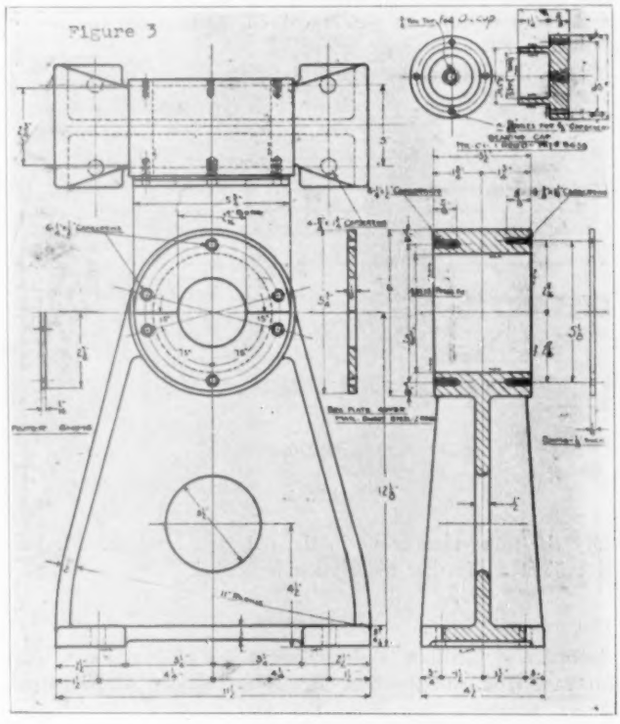


Fig. 3. Another Detail of Parts of Original Machine. Compare With New Design.

from cast iron parts should be readily understandable from the foregoing drawings and needs no further description.

The arc-welded machine, having a somewhat different method of production, the various operations and scheme of assembly may be of interest.

The first unit of construction is covered by Figure 5 and consists of the base or bedplate for the motor, brake, supports for worm shaft bearing, and supports for driving sheave or gear shaft bearings. The various shapes used are welded together in their respective positions as shown. The worm shaft bearing supports are then welded together, bored through and faced at one operation to insure perfect alignment of these bearings as shown in Figure 6. Since this unit is only a skeleton, machining these parts is advisable at this time because all work is in plain view of the machine operator, which results in more accurate work in less time than where a por-

tion of the work is partially concealed or not readily accessible when the assembly is more nearly complete before machining.

Second, the lower half of the gear housing shown in Figure 7 is welded together, dropped into position between worm shaft bearing supports and welded to these supports around

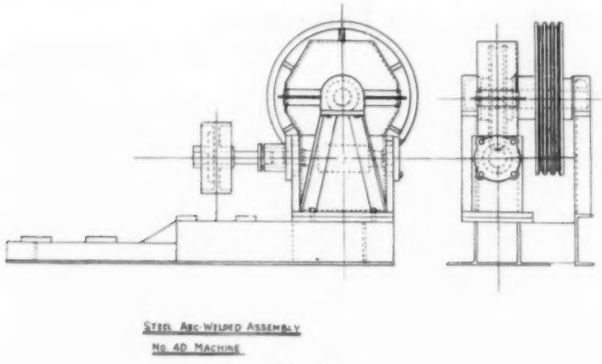


Fig. 4.

the circular opening in each end of the case to produce an oil tight joint. The diameter of these openings being somewhat greater than the machined bore in the bearing supports, no damage is done to the machined surfaces by the welding operation.

From this point the assembly process continues in prac-

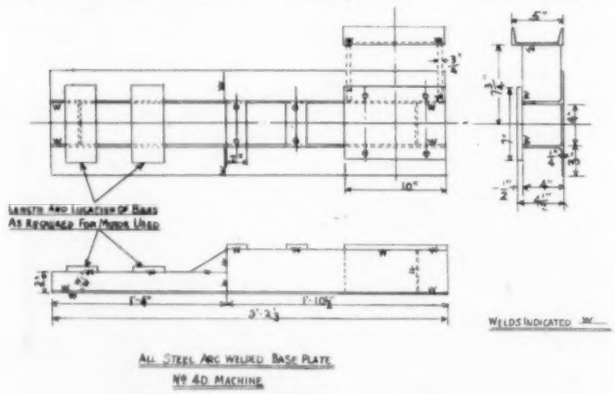


Fig. 5.

tically the same manner as in the old type machine, this being self evident no further description is needed.

Economies

In order to facilitate understanding and comparison of costs with cast iron construction versus arc-welded steel and the savings resulting therefrom the major items are arranged below in tabular form.

Part	Old Weight	New Weight
Base Plate	.....	**55**
Gear Housing Bracket	**320**	**40**
Gear Housing	.....	**30**
Outboard Bracket	**50**	**5**
Misc. Common Parts	**235**	**235**
Totals	**605**	**365**
Net Reduction	.....	**240**

Cost of old design at 5c *per pound* $30.25

Cost of new design at 3c *per pound for steel and* 5c *for cast iron* 15.65

Reduction $14.60 *or* 48%.

The cost of labor on the two designs remains practically the same. It would appear, however, that we may anticipate a reduction of about 5% due to the fact that different machinery may be used for machine work on the new design as compared with the old. We also anticipate a further saving by replacing some additional parts with arc-welded steel where the present design employs castings.

It should also be noted that a material saving would have

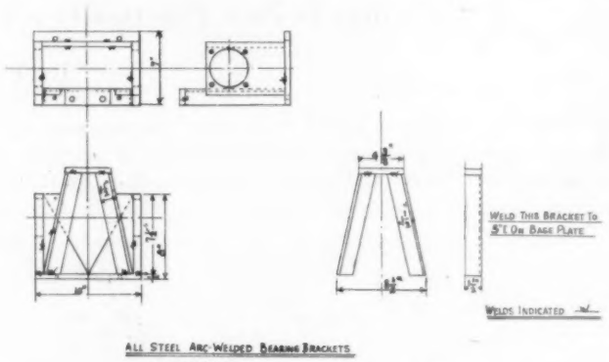


Fig. 6.

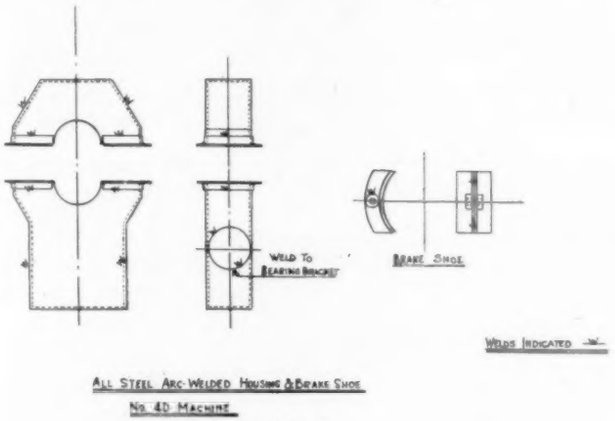


Fig. 7.

been made on patterns, had the machine been an entirely new design where patterns were not already available. Storage space for patterns and castings should also be charged off together with reduction of inventory for these items.

NEW FILM SHOWS USE OF ARC WELDING IN MANUFACTURING

A new educational motion picture portraying the advantages of arc welding and the widespread possibilities of its application has recently been released by The Lincoln Electric Company, Cleveland, Ohio.

Entitled, "Modern Manufacturing with a 'Stable-Arc' Welder," the new film compares the physical characteristics and costs of cast iron and rolled steel, also of cast iron, riveted steel and arc welded steel construction.

How to design for welded steel construction and how welded products are made is also told in the picture. Various applications of welding show the widespread possibilities of the new process of joining metal. The history of the commercial use of welding is briefly traced to the present time.

Though the film is produced by one of the largest manufacturers of welding equipment, the motion picture is delightfully free from advertising, making it a purely technical film. This in some measure probably accounts for the interest displayed at the premier showing made recently.

The motion picture is contained in three reels of standard size film, making it possible to be shown to large or small audiences. It is also available in 16 mm. film size. The film is offered gratis for showing upon application to The Lincoln Electric Company.

Gas Welding Light Gauge Sheets

Methods of Heat Control—Use of Jigs and Chills—Mechanical Welding Devices—Various Types of Joints Welded

By H. J. Grow*

IN STRIVING for the ideal joint the metal worker has always had in mind one whereby two pieces of metal could be placed in position and then merged along the line of contact. This ideal is realized in the oxyacetylene welding of light gauge sheets. The oxyacetylene flame affords that concentrated, easily

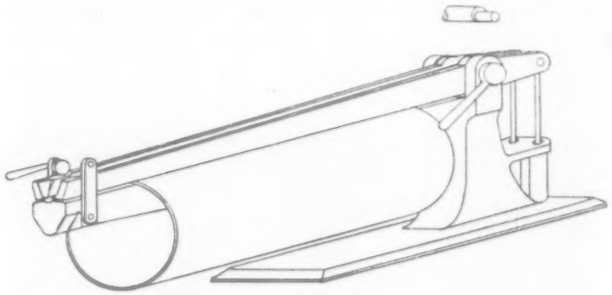


Fig. 1. Jig for Welding Longitudinal Seam on Cylindrical Work.

manipulated source of heat, under perfect control by the operator, both as to intensity and position, which makes continuously possible the successful achievement of such a joint. Moreover, the welding of light sheets is frequently effected by the mere fusion of the edges without adding metal from an outside source, which makes for a truly autogenous weld.

Generally speaking, the welding of light gauge sheets is a

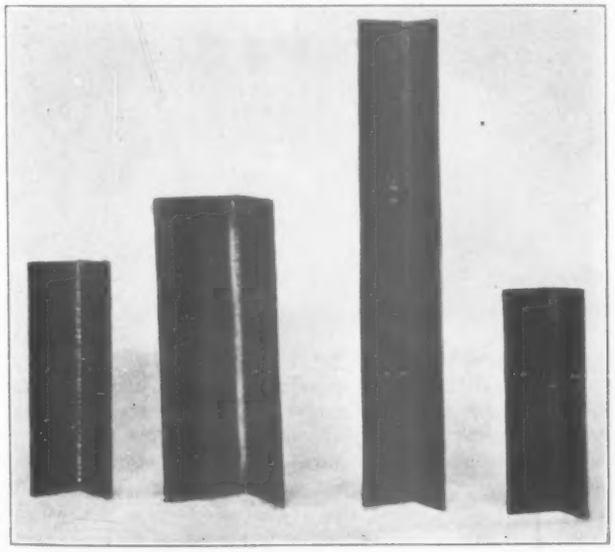


Fig. 2. Inside Corner Weld.

rather simple operation, easily learned and requiring only standard light weight apparatus. This apparatus consists mainly of standard welding torches which are obtainable in various types, and in several sizes. In connection with the torches there are required pressure regulators which reduce the tank or line pressure to that required for torch operation. Torches should never be operated unless the pressure is controlled by individual regulators, because constant and accurate pressure control contributes materially to efficient operation. The acetylene gas supply may be derived from cylinders containing dissolved acetylene for individual torch supply or from generators which automatically produce acetylene direct from calcium carbide and distribute it through pipe lines to the various welding stations. Similarly oxygen may be supplied from a cylinder for individual torch supply or cylinder may be connected in banks to a manifold from which it is distributed through pipe lines. For mechanical welding the only additional equipment required is a simple fixture or jig for holding the work and some means of obtaining a steady relative motion between the torch and the part to be welded. This motion may be obtained by holding the work stationary and mounting the torch on a mechanically-

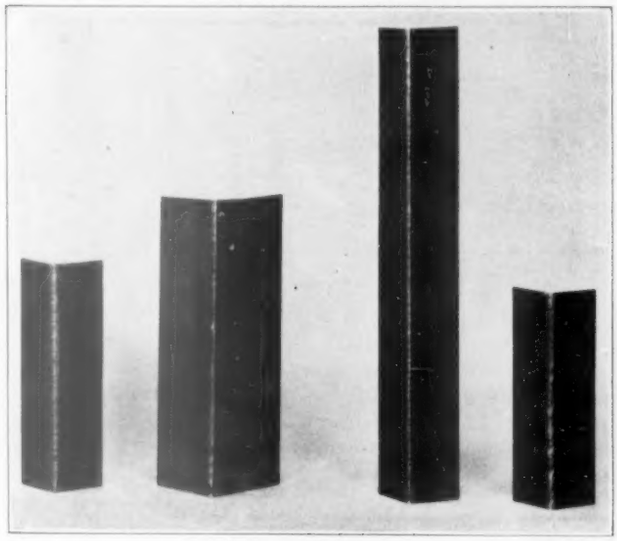


Fig. 3. Outside Corner Weld.

driven device or the torch may be held stationary and the work moved past the torch. The choice of method will, of course, depend on the article manufactured and other production details. Hence, it is obvious that the sheet metal fabricator who decides to employ oxyacetylene welding does not need to provide a large plant area for the accommodation of expensive machinery. The installation of simple and inexpensive equipment will make possible the production of fairly intricate sheet metal parts.

Since the logical development of mechanical welding usually proceeds from an intelligently supervised hand welding department and since hand welding and mechanical welding have so many points of similarity, it is felt that a brief consideration of hand welding problems at this point will lead to a better understanding of mechanical welding principles.

Certain products, especially those of irregular shape, such as automobile bodies, metal office and hospital furniture and airplane fuselages, are largely confined to the hand welding field. A discussion in detail of the method of welding these articles would be beyond the scope of this paper. There is, however,

*Engineering Research Dept., Air Reduction Sales Co., New York City.

a class of production involving the welding of long seams in cylindrical shells, the discussion of which will bring out very clearly some of the more important principles underlying sheet metal welding. Barrels, range boilers, and tanks of various sizes and purposes belong to this class, and probably the greatest application of the oxyacetylene torch in production welding of sheet metal is found in the manufacture of articles of this sort. An idea of the volume of this type of production may be gained

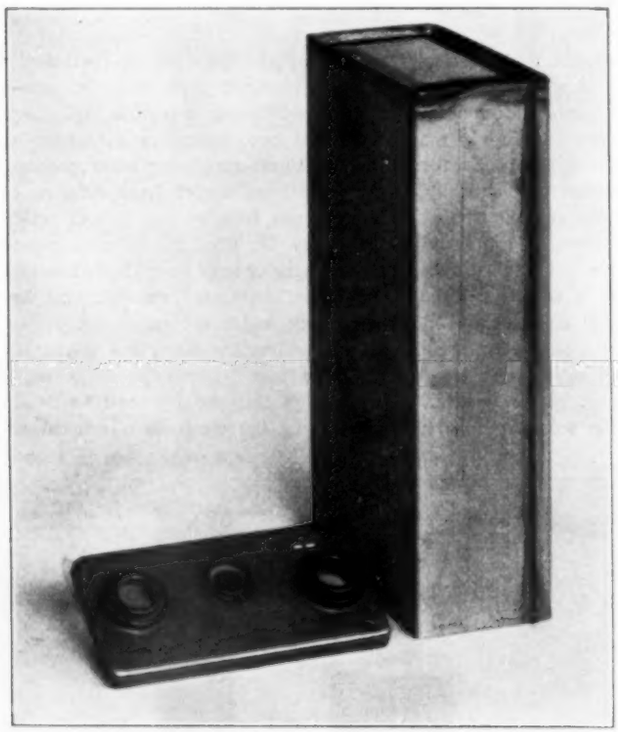


Fig. 4. Storage Battery Case.

from statistics recently published by the U. S. Department of Commerce which indicate that during the month of August, 1927, twenty-seven companies reported the manufacture of 615,152 steel barrels, and this is an average monthly production figure for the eighteen months previous. Practically all of these barrels had their longitudinal seams welded by the oxyacetylene process. The majority of those not so fabricated were made up with brazed seams.

Getting back to the longitudinal butt weld in the cylindrical shell, we will assume that the importance of getting good fusion and penetration is understood and we will rather concentrate on those other important factors which have a bearing on the speed of the operation and on the accuracy of the part welded. No matter what process of welding is used, whether it be forge welding, electric welding or oxyacetylene, some of the heat from the welded area finds its way into the main body of the part welded. The effect of this heat must always be anticipated in any welding operation and provisions made to counteract its action, if necessary. In the case of light gauge steel sheets, this heat may be controlled in any of the three ways or in combination, namely: by tacking and intermittent welding; by tacking and the use of small tips; or by the use of properly designed jigs and chills. The last named method is the one most commonly used in the larger shops where the production is sufficient to warrant it. The use of jigs is especially advantageous in the production of a larger number of similar parts because they add greatly to the convenience, economy, accuracy and speed of operation, and because they provide a positive control of the heat entering the work. Just as a machine tool jig, such as a drilling jig, has a dual purpose—holding the work and guiding the tool that acts upon it—so the welding jig in addition to holding the work, guides and to a large extent controls the flow of heat into the part being welded.

The common form of welding jig for cylindrical work comprises a horn or anvil properly shaped to hold the parts and a clamp or form which provides a V-shaped groove with a slot exposing the seam to be welded. It is necessary in most welding to provide a space or groove in the horn or anvil directly below the seam. The purpose of this air space is, of course, to prevent too much of the intense heat of the weld from being absorbed and hence diverted from its useful purpose. See Fig. 1.

One of the important advantages of the clamps, provided they are of sufficiently heavy construction, is that the sheets are shaped and brought into absolute alignment. The clamps also restrain the sheets so that they creep in at a uniform rate through the clamps to close the wedge-shaped opening always left between the edges of the sheet when the weld is started. The clamps are adjusted to a pressure just sufficient to allow the normal motion of the edges so that the shell is correctly positioned and properly shaped when the weld is finished. As a matter of fact, the reason for jigging, is to hold the parts in

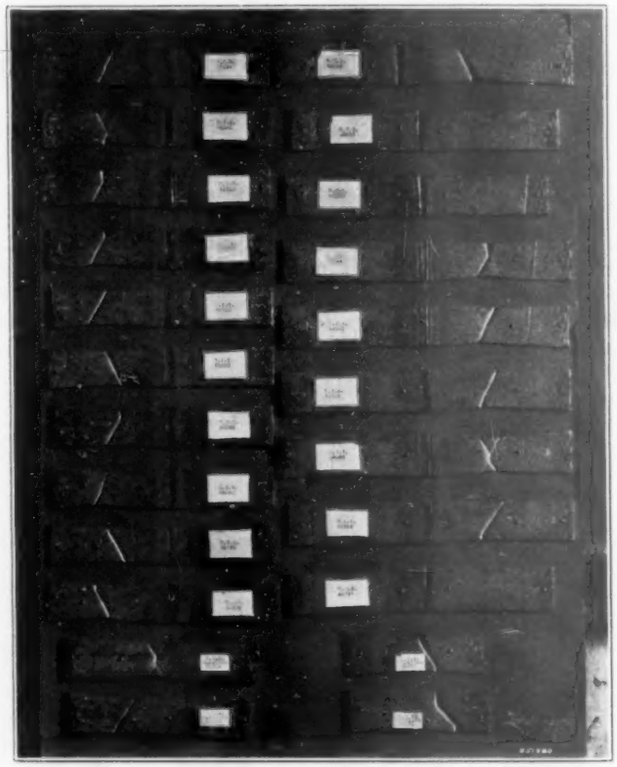


Fig. 5. Test Pieces, Gas Welded. No Metal Added.

position and the edges of the sheets in alignment so that absorption of the heat will be uniform throughout the length of the seam, and to smooth out any buckles or irregularities which might be present, either visible or locked up as a rolling strain, in the part prior to welding. The clamps also act as chills carrying off excess heat and allowing the use of a larger welding flame than would be possible without the use of clamps; this in turn means a greater footage of welding per day. With clamps, the heating and cooling is more uniform and, therefore, more simple to control.

Hence, it follows from what has been said above that in hand operations, the speed of welding depends upon the ability of the operator, the design of the jig and the absorption of heat from the welded area. Few welders, unless specially trained, acquire the same motions or are capable of welding at the same speed. Therefore, welders employed on sheet metal production work should be trained under the same supervision and the procedure of welding operations, planned and adhered to. It is necessary

that each operator's jig or the set up of the work in the jig be adjusted to his style and speed.

The design of the jig from a heat absorption standpoint has a very important bearing on the speed of welding. The width of the groove under the seam, the dimension of the V-shaped space in the clamp, as to depth and opening, and the mass of metal in the anvil and clamps are all important factors in determing how much heat will be directed into the weld and how much will be othewise distributed. Tied up in this same subject is the fact that the rate of welding and the design of the jig govern the contraction of the sheets from the wedge-shaped position previously mentioned. For any given size of torch flame, it is

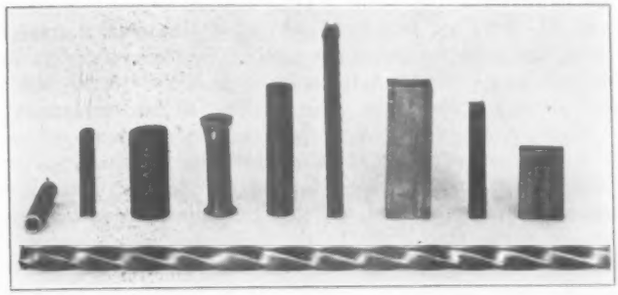


Fig. 6. Oxy-Acetylene Welded Tubing.

evident that as the torch progress is slowed down, more and more heat will be absorbed by the work. Now, this excess heat in the sheets not only magnifies the contraction of the intensely-heated and rapidly-cooling areas already welded but it also increases the movement of the edges of the sheet throughout the zone extending for a considerable distance ahead of that part of the seam already welded. Both the expansion and contraction, although acting in opposite directions, affect the wedge-shaped opening in one direction, that is, they tend to close it. Naturally, a larger wedge-shaped opening must be provided to take care of this effect. Moreover, the jig through both its restraining function and its heat absorbing function can be made to control this closing movement to a large extent. This explains more fully our previous statement that the set up may have to be varied to suit the welder's style and speed.

The types and construction of jigs are as varied as the articles produced on them. They are usually the result of a gradual development and expansion of the process in the plants where they are found, and most of them are ideally suited to the product made by their use. In other words, the jig must be made to fit the job, always keeping in mind the results that are desired. If speed of production is the paramount requirement, the jig should be as simple as possible. If it is desired to produce an article accurate within very narrow limits and of a quality so high that the cost of production is not the leading factor then the use of very complicated and elaborate jigs may be warranted. However, in most cases, the desired results are obtained with jigs of simple design.

A welding jig should be easy to load and unload. It is usually constructed so that parts can be quickly placed and the finished product speedily removed. In this connection, it is well to remember that in the case of jigs which are loaded cold and unloaded while both jig and the work are hot, proper allowance must be made for expansion between the jig and the work, so that there will not be a tendency for the work to bind in the jig.

The simple clamps that are found in practical use and which lock and unlock readily are essentials of an easy operating jig. They are positive in action, lock the work firmly in place and when disengaged afford a clearance that will permit easy loading and unloading. It is desirable that they be adjustable to take various thicknesses of sheets and to exert a suitable holding pressure in accordance with the requirements of the job and each operator's welding speed.

It is necessary that provision be made so that contraction and expansion stresses do not affect the accuracy of the jig or the welded product. In general, distortion of the jig and parts is to be avoided unless the work is of such a nature that distortion in a certain direction facilitates the welding operation and counteracts a distortion which would otherwise develop as an after effect, due to the cooling and the form of the product. As an example, consider the case of the cylindrical shell jig previously mentioned. The amount of contraction which will take place as the weld cools depends upon the speed at which the weld was made and upon the design of the jig. This contraction can be estimated or determined by trial and the proper allowance made.

From what has been said of the heat-absorbing function of the jig, it is evident that provision must be made not only for the absorption but for the conduction and radiation of considerable quantities of heat by the jig. This is usually accomplished by providing sufficient metal in the jig members to absorb and carry away the heat, although less frequently, water-cooling of the jig is resorted to. Those jig members which must hold the

Fig. 7. White Lead Can.

sheets in line while being subjected to heat from the welding flame should be made preferably of cast iron. Rolled steel members generally are not satisfactory for this service as they change shape more rapidly under repeated heating and cooling.

The demand for increased production has led many manufacturers to introduce mechanical gas welding into their plants. Mechanical welding by the oxyacetylene process with properly designed machines and accurately formed parts often insures a production of from three to ten times that possible by hand welding methods. This is possible by reason of the ability to employ torches of greater capacity and tips or burners having a multiplicity of flames which spread the heat over a greater length of seam and because the steadiness and uniformity of application of the flame to the work makes for increased speed and economy. Mechanical welding also permits the operator to utilize some of his time in placing the work in the jig or otherwise preparing parts for welding, thus frequently eliminating the need for a helper. A good example of this last benefit is found in the mechanical welding of battery boxes where the operator is able to place the work in the jig and revolve it at the proper

point while a mechanical device carries the work past the welding tip in a straight line. Among examples of mechanically-welded products, may be mentioned barrels, auto mufflers, tubing, paint cans, milk cans, refrigerator linings and storage battery cases.

The simplicity which is characteristic of hand welding can still be maintained when mechanical methods are introduced. There is one requirement, however, which must receive greater consideration when mechanical methods are planned and that is a more careful preparation of the work. This means that the sheets must be accurate as to size and accurately formed. It means, furthermore, that the sheets must be of a uniform gauge and quality. It usually means that the sheet must be resheared, as mill-shearing is not satisfactory. No matter how careful

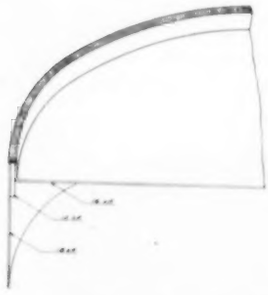


Fig. 8. Reinforced Edge Weld.

Fig. 9. Oxy-Acetylene Lap Weld.

and intelligent the welding application it cannot overcome defects in material or preparation.

Mechanical welding makes possible the setting of the torch at the proper and most economical angle to the work and the holding of this angle constant. The hot gases of the outside envelope of the torch flame protect the welded area against too rapid cooling and the reducing atmosphere which is present protects both the top and under side of the seam from oxidization. Both of these features tend to insure a high quality metal in the weld. Hence, mechanical welding produces uniformity in quality, appearance and strength of the weld with maximum production per torch.

The protective effect of the reducing atmosphere is clearly indicated by the condition of the metal along the corner welds shown in Fig. 2 (a) and Fig. 2 (b). The protection is especially complete on the under side of the weld. See Fig. 3 (a) and Fig. 3 (b) which show the reverse or inside corner of these same welds. Here the steel is so free from oxidization that it has assumed a bright polished appearance, although no finishing has been done and the welds are just as they came from the welding flame.

Mechanical welding may be classified as semi-automatic in which the operator attends to but one machine and which involves considerable handling of the work, and as that which more nearly approaches full automatic operation in which one operator can divide his time between several machines.

The welding of the battery case mentioned above is a good example of work which falls into the semi-automatic class. This battery case, which has its top and bottom edge seams, its longitudinal seam and spuds mechanically welded is shown in Fig. 4. The application of mechanical welding to this product necessitated little more than furnishing an adjustable fixture for holding the torch and provision for conveying the jig past the torch flame so that the flame could be directed against the edge seam. Upon completion of the weld along one seam the operator revolves the jig through 90 degrees and the following edge is welded and so on for all four sides without interruption.

In another plant semi-automatic mechanical methods were devised for the welding of longitudinal seams in automobile exhaust mufflers. In this case, the mufflers to be welded are mounted in special jigs supported along the edge of a bench. A small motor-driven machine carrying a welding torch travelled along tracks on the bench to which the jigs are mounted and thus applies the torch flame at a uniform speed to accomplish the welding.

For the production welding of the long seams of cylindrical shells such as are used in boilers, tanks and barrels, there is available a machine which consists essentially of two work-holding arms which stand opposite each other and are mounted on a pivot, forming a turret fixture which is loaded and unloaded at one station and welded at the other. The welding arms, which are water-cooled, are placed in a horizontal position and the shells are held by clamps while the torch is traversed along the seam by an electric motor. One torch only is used on thin gauge metal but the machine provides for two torches, one above and one below when working on heavier gauges.

Figure 5 shows a series of test pieces which were cut from a single seam welded in 12 gauge sheets on this machine. It is interesting to note that only three out of the nineteen test pieces broke in the weld and that the ultimate tensile strength of the pieces that broke in the weld closely approached the tensile strength of the unwelded sheet. This is characteristic of the high quality work which it is possible to accomplish by mechanical gas welding methods.

Types of mechanical welding which require a minimum of the operator's time enabling him to attend to a number of machines at the same time, are best exemplified by tube welding machines of which there are approximately 250 in daily operation in this country producing over half a million feet of gas-welded steel tubing in a 9-hour day. The variety of this welded tubing as to diameter and gauge and its ability to withstand distortion and forming operations is well illustrated by the samples shown in Fig. 6. Paralleling the development of tube welding and greatly contributing to its wider application has been the development of rolling mills for producing the sheets from which the tubes are formed. The accuracy of rolling with these mills is quite remarkable. It is now possible to hot roll strips 250 feet long, 30 inches wide and 1/16th inch thick, with edge to center and end to end variation within 0.003 inch. Another example of welding that approximates the full automatic is found in the manufacture of special paint cans. This job is being done by methods which are so nearly automatic that one man can attend to as many as six machines.

Figure 7 shows such a can the longitudinal seam of which has been welded by this automatic method. It is to be noted that the weld successfully withstands the severe distortion incident to beading the side sheet over the bottom of the can. (Shown at the top in the illustration.)

While most of our discussion has dealt with butt-welded seams it should be realized that mechanical gas welding is not limited to this type of seam. Various combinations of edge welds lend themselves very nicely to mechanical welding application. Such edge welds are found in cylindrical and square containers where a flanged bottom is to be welded to the side sheets. In some constructions it is desired to weld the edge of a reinforcing member between the edges of the main sheets. See Fig. 8. This variety of edge weld is also easy of achievement by mechanical methods. On certain articles it is frequently desired to make a corner edge weld on sheets at right angles to each other. See Fig. 2 and Fig. 3. The simple expedient of a torch, mechanically propelled along the edges of the clamped sheets on this sort of construction, usually effects the elimination of most of the handwelding previously required with the consequent gain in efficiency. The very accurate control which is possible when using mechanical welding methods is well illustrated in Fig. 3. Welds 3 (a) and 4 (b) have penetrated to the extent that a bead is developed along the inside corner, while welds 3 (d) and 3 (c) made on the same gauge metal respectively as 3 (a) and 3 (b), have a perfectly square inside corner without any vis-

ible penetration. The welder can produce either finish at will.

Figure 9 illustrates a type of lap welded girth seam which has been accomplished by mechanical gas welding.

Our subject limits us to consideration of only the lighter gauges of steel, and while most of the earlier development has been made in the field between twenty gauge and ten gauge, the gauge of the metal is no barrier to mechanical operations. By the extension of the principles and operations of light gauge welding, the heavier sheets are usually welded more easily. There is even the added advantage that by certain manipulation the preparation of the heavier sheets can be made less and less exacting.

When the mechanical welding of alloy sheets is under consideration it will be found that the oxyacetylene process is singularly adaptable.

Oxyacetylene welding is not an incident in the manufacture of sheet metal products, it is more often the process which makes economical production possible and should, therefore, be given the same consideration that is given to mechanical manufacturing methods.

The next few years will see great strides made in the application of gas welding and particularly the automatic or mechanical application of this process. This is a natural and necessary development and one which is being brought about by the demand for more and more production. The elimination of the human element and the ability to depend with absolute assurance on a continuous production of uniform quality with a minimum of supervision is an accomplishment the attainment of which is worth all the thought and effort required.

A REVIEW OF ELECTRIC ARC WELDING DEVELOPMENTS DURING 1928

By L. S. Thurston, Industrial Department, General Electric Co.

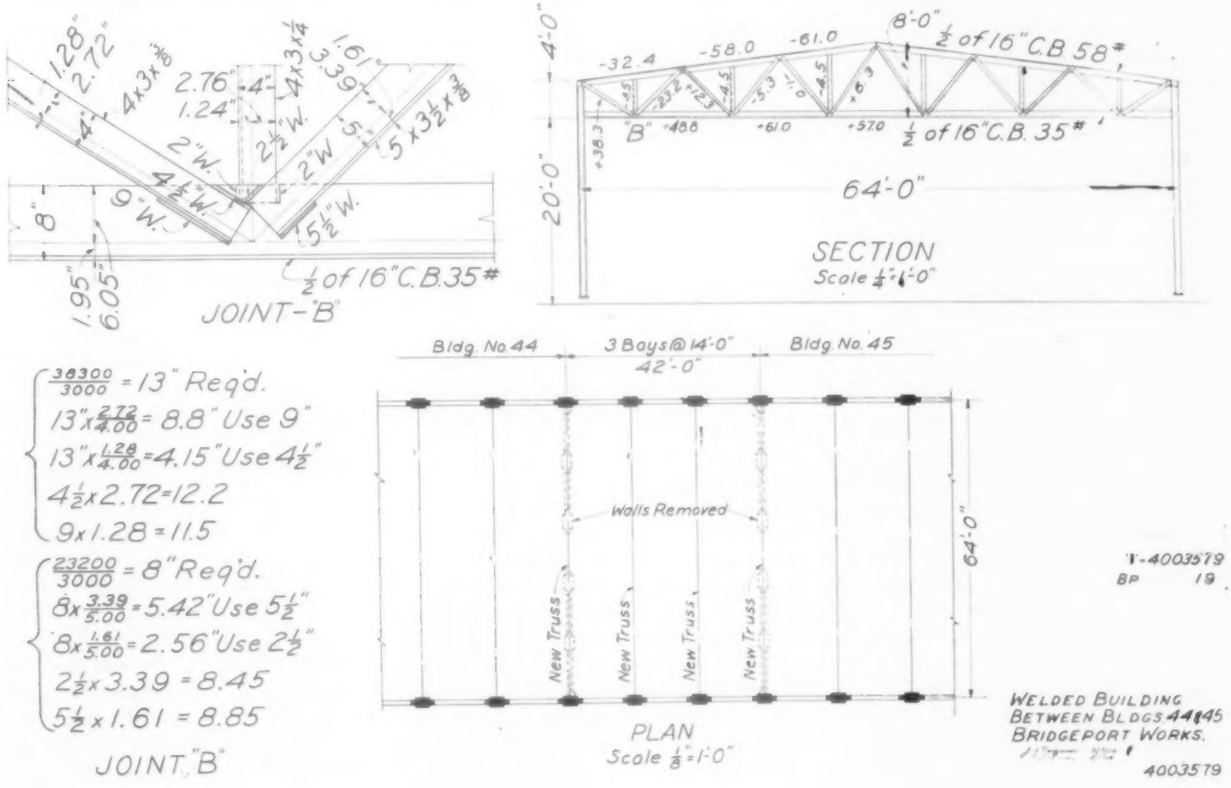
The outstanding development in electric arc welding during 1928 was the decided stimulus it received in its application to the fabrication of steel buildings. The development, during the latter part of the preceding year, of a welded roof truss, together with the ability to use structural steel columns and girders without difficulty in a welded structure, made considerable progress possible.

From a popular standpoint, the advantages of eliminating the din of riveting through the use of a silent method of welding, are obvious. From a practical standpoint, the electrically welded structure has been proved to be beyond the experimental stage. Design can be calculated in advance, as is evidenced by the existence of almost 50 welded steel buildings now in use, in none of which failures have occurred.

Experience during the year proved that the welded structure can be made with less material than the riveted structure for the same loads and safety factors and that, as shop methods are developed, it will be possible to fabricate buildings by the use of welded joints cheaper than they can be fabricated by the use of riveted joints. This, it is expected, will lead to the use of welding as a means of economy.

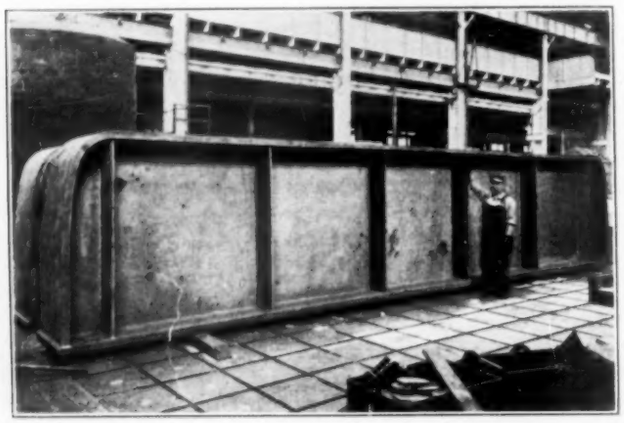
The most impressive application of electric arc welding to building construction completed during the year was the fabrication and erection of a 1,000-ton factory building for the General Electric Company at its new plant in West Philadelphia. This building, now completed and occupied, involved at the time of its erection a number of new design features including the use of the welded roof truss. The structure is approximately 140 feet wide, 600 feet long and 50 feet high. The principal elements from which the building framework was constructed were welded in the shops of the American Bridge Company in Trenton, N. J. These were delivered to the building site and the remainder of the work, necessary to fabricate them into the form of the completed structure, was done on the spot with field welding. Two portable welding sets were all that was required during most of the field welding, although three were used at times. The majority of the welding was done with $\frac{3}{16}$-inch fillet welds, $\frac{5}{16}$-inch fillets being used to some extent at various times.

Following the erection of the West Philadelphia building, two more factory buildings of smaller size were erected, also for the General Electric Company. One of these is an addition to its plant at Bridgeport, Connecticut, and the other is located at the company's Pittsfield, Massachusetts, plant. The



Bridgeport structure is a single-story building 64 feet wide and 42 feet long. It connects two previously existing buildings. The Pittsfield building is a two-story structure of beam and column construction, about 40 feet wide by 280 feet long, and contains about 250 tons of steel. Fabrication of the trusses and other complete members for these buildings, like that at West Philadelphia, was done by the American Bridge Company in its Trenton, N. J., plant.

Another interesting application of welding in this field was made during the year by the Dallas Power & Light Company which erected, at Dallas, Texas, a 40-car welded garage for the protection of employes' cars. By utilizing structural steel that would otherwise have been scrapped, the total cost of erecting this structure was reduced to but 25 per cent of the



Welded Plate Girder for Bridge Construction Effects Saving in Weight.

lowest contract price for an equivalent riveted structure. A single portable welding equipment was all that was necessary to do the work.

This garage is made of steel angle-iron framework covered with corrugated galvanized iron. There are two units, each 16 by 140 feet, divided into ten spans each 14 feet wide, and each unit capable of covering 20 cars. The units face each other with a 22-foot driveway between. The steel used was salvaged from the framework of an outdoor switching structure which became obsolete with the addition of generating equipment to the power plant. The varying lengths of the steel members removed from this structure, together with the numerous holes already punched for the switching structure (which would have interfered with the punching of new holes to fit the garage design) would have made it necessary to splice or junk the greater part of the steel if a type of construction other than welding had been used. As the company had in its possession at the time a portable welding equipment, it was a simple matter to fabricate the structure by welding.

A further impetus, during the year, to this art was given by the design by Frank P. McKibben, Consulting Engineer, Black Gap, Pa., of a welded plate girder which, according to his calculations, affords a saving of 15.2 per cent in the weight over the riveted type. Mr. McKibben, at the end of the year, was engaged on an extensive lecture tour covering a large part of the United States, discussing the application of electric arc welding to the noiseless construction of structural steel buildings and bridges.

A marked improvement in the technique of welding pipe lines was the result of the construction, during 1928, of such a line to supply water to the city of Springfield, Mass., and running from the Provin Mountain reservoir over a distance of seven miles to the city. Dropping more than 300 feet in elevation, this line passes under the Connecticut River on the way, and is the longest welded pipe line in the east.

Construction was carried on by Daniel O'Connell's Sons, contractors of Holyoke, Mass., and Walsh's Holyoke Steam Boiler Company of the same city. Pipe sizes vary, including diameters of 36, 42, 48 and 54 inches. The plate used varies in thickness from $\frac{5}{16}$ to $\frac{1}{2}$ inch. Welding was accomplished automatically by the multiple-arc process employing two arcs, one following about eight inches behind the other. By using two travel carriages with a total of four arcs working simultaneously, a 50 per cent saving in welding time per pipe was effected over that necessary with one travel carriage and two arcs.

An interesting development in the railroad field was the extension of the use of the welded metal railroad tie to switches cross-overs and other types of track. This form of tie, fabricated from scrap rail and believed to be much less expensive than the common wooden tie in many applications, was first announced during 1927, when a trial section of track was equipped with welded ties by the Delaware & Hudson Railroad.

The extension of application in 1928 was made at the entrance of the D. & H. R. R. Co.'s tracks to the plant of the General Electric Company in Schenectady. Up to that time, such ties had been used on straight track only. The new installation includes all types of track which are commmonly used in railroad service, with the exception of track involving the signaling function on which development work is still in progress. Not only were the switches and cross-overs mounted

Welding Large Pipe by Multiple-Arc Process Gives 50 Per Cent Saving in Time.

on metal ties, but the switch stands themselves were mounted on extra long metal ties. By a simple arrangement the base, on which a switch stand is fastened was welded to the ties, resulting in a firmly fastened stand but allowing its easy removal for replacement or repair if necessary.

The Delaware & Hudson Railroad Company maintains a metal tie fabricating shop at Colonie, N. Y., built around an automatic arc welding machine specially designed and constructed by the G. E. Co. for this product. Its present output is about 20,000 ties per year which is entirely covered by requisitions from the various operating divisions. Metal ties were adopted as standard, during the year, by the Delaware & Hudson Railroad for everything except signal track.

New Equipment

An improved combination of electric arc welder and Fordson tractor, announced during the year, involves a new type welding equipment and the addition of head and tail lights and a protective cover. The unit consists of a standard Fordson tractor belt-connected to a type WD-300-A, 25-volt, 300-ampere, one-hour rated 1750-r.p.m., ball-bearing generator. The welding generator is mounted directly on an extended frame of the tractor and is protected from the weather by a metal canopy and canvas side curtains. The overall length of the complet unit is 12 feet; the height is 4 feet 8 inches; the width is 5 feet 2 inches, and the net weight is approximately 4,900 pounds.

Among other applications, this equipment will be found particularly useful to welding contractors, boiler shops, marine repair shops, structural field contractors, oil well drilling companies, oil refineries, pipe line owners and tank builders. For field use, the unit will haul equipment and tools to the job and then supply current for the welding.

During the year an improvement was announced in the control equipment used with automatic arc welding heads, by means of which the feed of electrode wire is stopped a short time before shutting off the welding current at the end of the weld. This serves two purposes: first, it clears the electrode from the weld and, second, it fills in the crater which is usually left at the end of the weld when the arc is cut off short.

Such an improvement is particularly desirable. By keeping the electrode clear of the weld when removing the work from the clamping fixture, the end of the wire is prevented from dangling—of particular importance with large sizes of wire. The undesirable crater is also objectionable, especially on circular welds of small diameters where one end of the weld is lapped over on the other end. Control of this equipment is simple, involving the use of but two push buttons.

STRUCTURAL WELDS TO BE MADE AND TESTED AT MEETING OF DETROIT SECTION

Arc Welding as applied in the erection of steel fabricated buildings will be the topic of the meeting of the Detroit Section of the American Welding Society to be held at the University of Detroit, Saturday, February 16th, 1929. This meeting is for the benefit not only of members of the Society but also for engineers, architects and students interested in the application of welding to steel erection.

Mr. A. M. Candy, manager of the welding section of the General Engineering Department of the Westinghouse Electric and Manufacturing Company, and an authority on structural welding, will speak on the subject and will direct the making and testing of actual specimens. Mr. R. G. Richards, President of the Detroit Section, will act as chairman of the meeting.

Welding apparatus from many different manufacturers will be used in the welding of samples that are to be made up for the inspection of the attendants, this being a general combined endeavor to convince erectors of the value to welding in their art.

The meeting is scheduled to start at 11:30 A. M. in the Engineering Building of the University of Detroit—6 Mile Road and Livernois Street. The intention of the meeting is to elaborately display the welding of structural steel. One of the features of the show will be the projection on the screen of an arc while in operation. Motion pictures and a number of slides will also be shown depicting the progress of structural steel welding throughout the world. Experienced operators will demonstrate the adaptability of both A.C. and D.C. arc welding as applied to this field.

Distribution of the blue prints and drawings of specimens will be made and tested and designs of joints, kind of material, weights used, purpose of connection, load carried and other engineering data will be furnished as it relates to welded specimens.

Specimens will then be welded before the assembly and immediately after this has been done, the party will adjourn to the lecture room where those in attendance may hear from authoritative sources the results and reasons why arc welding is being so readily adopted by many engineers.

From the lecture room to the physical testing laboratory where destructive tests of the welded samples will be made, the testing machines giving accurate evidence and proof of the exceptional merit of the weld for constructive purposes.

Invitations to this meeting are being made to all members of the following organizations: Members of the Michigan Society of Architects, Local Chapter of American Institute of Architects, and all members of the Associated Technical Societies, including the Engineering Institute of Canada, Students of Engineering and Architecture of the University of Michigan, University of Detroit, Michigan State College, as well as engineers, architects, fabricators and contractors interested in arc welding as applied to this work. This meeting and demonstration promises to be an excellent educational project, and with the welding interest so many builders have already shown a large attendance is expected.

CHICAGO SECTION AND WESTERN SOCIETY OF ENGINEERS HEAR McKIBBEN ON STRUCTURAL WELDING

The Chicago Section of the American Welding Society was invited by the Western Society of Engineers to join with them in their meeting of January 7th, to hear Mr. Frank P. McKibben, Consulting Engineer for the General Electric Company, who spoke on "Structural Welding." Mr. McKibben, who has long been connected with the design, fabrication and erection of arc welded bridges and buildings, presented a paper covering the subject in great detail. The meeting was attended by a number of architects and structural engineers who are interested in the progress being made in the welding of steel frame buildings.

PROGRAM OF IOWA STATE WELDING CONFERENCE

The following program shows the variety and practicality of the subjects covered by the speakers at the welding conference held at the Iowa State College of Agriculture and Engineering at Ames, Iowa, as announced in the last issue:

Wednesday, Jan. 16

Forenoon—Registration—Room 104 Engineering Hall.

1:00 P. M.—Opening of Conference—Room. 207 Engineering Hall.

History and Possibilities of Welding—A. W. Swift, The Welding Engineer, Chicago.

Recent Applications of Arc Welding to Industry—T. S. Peasley, General Electric Company.

Developments in Oxy-Acetylene Welding—S. C. Clark, Linde Air Products Company.

Demonstrations—Arc Welding Copper Alloys—General Electric Co.

Pipe Welding—J. M. Dulaney, Linde Air Products Co.

Thursday, Jan. 17

9:00 A. M.—Report on Investigation of Welded Joints—H. L. Maxwell, Chem. Engr. Dept., Purdue University.

Structural Welding—A. M. Candy, Westinghouse Elec. & Mfg. Co.

Demonstrations—Structural Welding—W. A. Pearson, Westinghouse Elec. & Mfg. Co.

1:00 P. M.—Welded Pipes in Buildings—Motion Picture Film from Gas Products Association.

The Use of the Bronze Filler Rod—Martin Brandenberg, American Brass Company.

Welding Thin Metal—Air Reduction Sales Co.

Demonstrations—Use of Bronze Filler Rod—R. P. Monroe, C. B. & Q. Railroad Co.; Martin Brandenberg, American Brass Co.

Welding Thin Metal—Air Reduction Sales Co.

Friday, Jan. 18

9:00 A. M.—Welded Parts in Manufacturing and Maintenance—John Vanhorne, Lincoln Electric Company.

Hard Facing Wearing Surfaces—R. L. Lerch, Haynes Stellite Co.

Demonstrations—Maintenance Welding—John VanHorne.
Stelliting—R. L. Lerch, Haynes Stellite Co.

1:00 P. M.—Round Table Discussion of Problems not covered in Program.

Special Demonstrations will be arranged during this session to help you solve your individual problems.

There are no fees in connection with the conference, and any one interested in welding is invited to attend.

Rooms may be secured at the Sheldon-Munn Hotel.

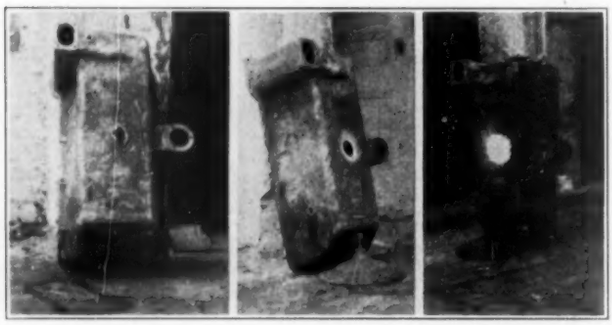
Address inquiries concerning the conference to Engineering Extension Service, Iowa State College, Ames, Iowa.

THE PLACE FOR ALUMINUM SOLDER IN THE WELDING SHOP

In the past Aluminum Solder has been a much abused article, partly because of the difficulties encountered in its use, and partly because of the many inferior products that have been placed upon the market. Some of the difficulty has been due to the failure of the solder manufacturer to appreciate the problems of the user, and to the absence of sufficiently clear instructions for application.

A good aluminum solder should fulfill several requirements; it should be made from high grade metals under technical control so that a uniform and homogeneous alloy is obtained; it should be readily workable by the average mechanic and should not deteriorate to an appreciable extent with age.

Aluminum Solder can be used to advantage by any shop for minor aluminum repairs, the chief advantage in its use being the elimination of preheating. Aluminum Solder can be applied at about 350° F.



Left—Crank Case, Showing Break. Center—Metal Cleaned in Preparation for Tinning. Right—Break Filled in With Solder.

It is not the purpose of this article to detract from welding as a method for repairing aluminum, but to show that there is a place for aluminum solder in the welding shop. Taking for an example a crank case with a crack or break in it, let us describe briefly a method of repair with solder.

The stock is cleaned and grooved or chipped to expose a clean surface and then, with a torch, brought up to a temperature of about 350° F. in the immediate vicinity of the break. The solder stick is then rubbed on the work which is hot enough to melt the solder and the entire surface to be repaired is tinned. After the tinning operation the remainder of the opening or break is filled in with solder and the repair completed. At no time in the soldering operation does the temperature of the casting need to exceed the melting point of the solder, which should be around 350° F., and all the dangers caused by preheating are eliminated.

The photographs illustrate the character of repairs that can be made effectively and economically by the use of aluminum solder. Such a job can be done in a few minutes time by an experienced welder. Aluminum solder opens to the welder a larger field and consequently greater demand for his services, without conflicting with his welding activities.

SILVER BRAZING AND SOLDERING, IN AIRPLANE CONSTRUCTION

By R. R. Shuman

An interesting example of the degree to which airplane manufacturers subordinate everything to the safety factor is the manner in which they use silver solders in brazing parts of their ships or motors that are subject to vibration or are likely to encounter relatively high operating temperatures.

Inquiry on this subject at the recent International Aeronautical Exposition at Chicago developed some interesting facts.

For instance, the Siemens and Halske attendant showed how that great German firm used silver solder in its airplane motors. Push rods, steel bushings on the steering bridge, as well as all copper pipe connections on both fuel and oil lines were brazed with silver. This material was employed because of its resistance to shock and vibration, as well as because it withstands relatively high operating temperatures.

The Wright Aeronautical Company attendant showed how silver solder was used in brazing external oil lines and push rod bushings on airplane motors. He stated also that the joints on the water pipes of the Wright Marine Engines were silver welded. From another source it was learned that silver solder is used in attaching flanges at several places in the Wright airplane motor; also for soldering the thermocouples.

Mr. Charles H. Day, vice-president of the Gates-Day Air-Craft Corp., Paterson, N. J., and a veteran airplane designer, said: "Gasoline and oil lines on airplanes are subjected to tremendous vibration. For this reason silver solder should always be used in the brass couplings of the copper fuel and oil lines. Silver seems to be the only welding material that will be proof against such vibration."

In some makes of motors silver is used in joining feed lines to the carburetor. Some employ it in the connections of control wires and cables.

Mr. N. V. Clements of the Garden City plant of the Curtiss Aeroplane and Motor Co. replied to a written inquiry, to the effect that their main use of silver solder is soldering brass connections and fittings to copper fuel and oil pipes.

My attention was called to U. S. Army specifications. Bulletin 57-97 A, of April 15, 1926, which, together with form 57-0, makes the use of silver solders mandatory for certain applications in the construction of army planes, notaby for joining all copper tubing.

Only a few people were interviewed because it soon became evident that "silver-welding" in some form was standard practice in the industry, though its application differed with the design of the ships or their motors.

Silver Solders fuse at from 1600° F down to 1325° F according to their silver content, the higher the silver the lower the fusing point.

In addition to their strength, toughness and resistance to relatively high operating temperatures they are described as having even a higher factor of electrical conductivity than copper; explaining their use in securing resistance wire to terminals and leads, in radio resistors, or in all other places where it is important that resistance be kept at a certain value.

My information is that commercial silver solders have recently been standardized to a dozen definite formulas; the richest mixture has 80 per cent silver and the leanest 10 per cent with various proportions of base metals.

Silver solders are usually sold by the Troy ounce, in the form of wire, strips, sheets and filings. They are applied by means of oxy-acetylene or other welding and brazing torches. Though called "solders" their function is usually that of a brazing medium.

Design of Small Welded Structures*

A Method of Making Drawings for Welded Structures Which Furnishes the Welder With All the Necessary Specific Information

By Norman H. Mayhew*

FOR many years it has been the dream of designers to plan their steel buildings or structures in such a manner that the steel could be shipped directly from the mill to the job. A design of this kind would require only simple forming at the final location to complete the project. In the usual riveted or bolted design, it is necessary to have the steel pass through the fabrication shop as there are countless holes to be punched, angle clips to be riveted in place, special cutting, etc. The nearest approach to the designer's dream is afforded by electric arc welding.

Many designers have been skeptical about the use of welding and have limited its use to minor applications. With arc welding as a new process, little definite information was available for the designer to work with. Thus, it was a natural thing for the designers to take this attitude as they have much at stake and must be sure of their step. The application of electric welding, however, has progressed in a very thorough and painstaking manner. This is proven by the success which has accompanied the expansion of welding applications. A few minor failures which have occurred can be traced chiefly to misunderstandings between the designer and the welder, and not to any fault of the process. For example, there has been no standard method of specifying on the drawing just what size and length of weld was to be made.

The drawings of welded structures formerly simply specified "weld" at certain points; depending upon the welder's judgment as to the amount of metal to deposit. The welder has done his job well but perhaps he does not know just what use is going to made of the completed structure. Not having the complete picture before him as does the designer, it is essential that some means be adopted to furnish him with specific information

One method of making drawings for welded structures which has proven very successful is hereby presented.

When the welds on the drawings are visible, they are shown by means of a heavy solid line with its length representing the length of weld. Where the welds are hidden from the observer, they are indicated by a heavy dash line. There is also a note giving the size and length of weld as well as any other notation which might be helpful to the operator. The use of this method is illustrated by the drawings in this publication.

*Design Engineer, Westinghouse Electric & Mfg. Co.

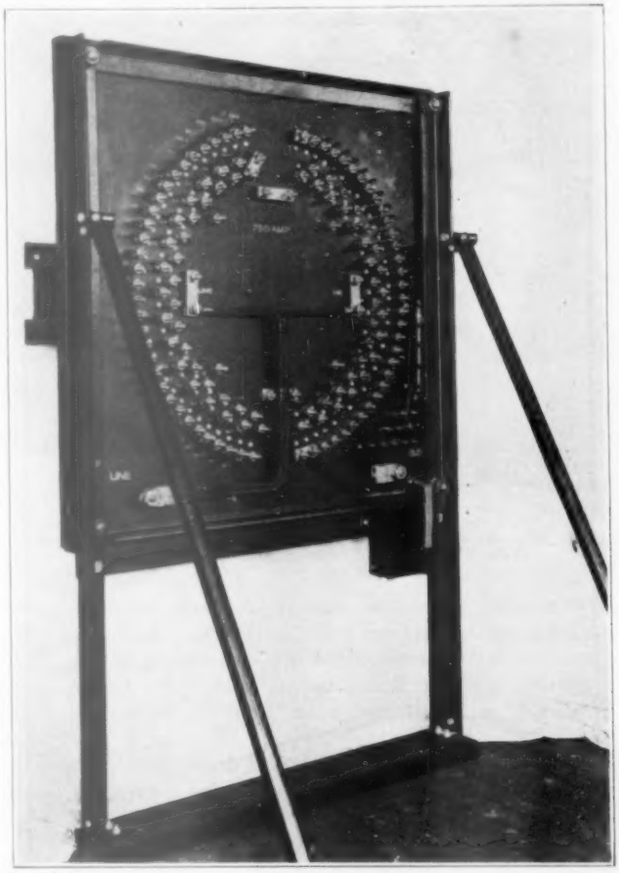


Fig. 2. A Bolted Frame With Face Plate in Place. The Frame Is Similar to That of Fig. 1.

Figure 1 is the working drawing of a welded frame for supporting the face plate of a large rheostat. The simplicity of the design is apparent. Five pieces of steel comprise the bill of material and welding completes the frame. Item No. 1 on the drawing, the side angles, are made ¼"x3"x3" angle. Item No. 2 is made of ¼"x1½"x1½" angle; item No. 3 is a piece of 3" channel, and item No. 4 is a piece of 4" channel.

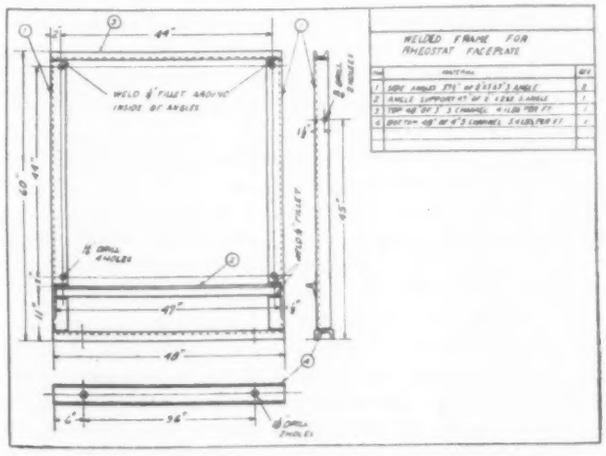


Fig. 1. Working Drawing of a Welded Frame Which Is Used to Support the Face Plate of a Large Rheostat.

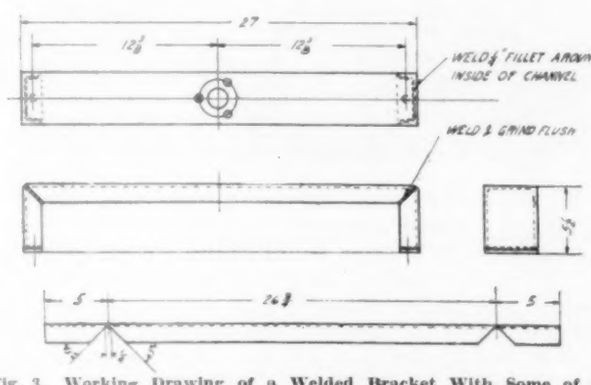


Fig. 3. Working Drawing of a Welded Bracket With Some of The Dimensions For The Drilled Holes Omitted.

A bolted frame equivalent to that of Figure 1 would have eight pieces and some of the angles would require special cutting at the corners. In addition to this, a number of bolts, nuts, and washers would be needed.

The photograph, Figure 2, shows a similar frame which is

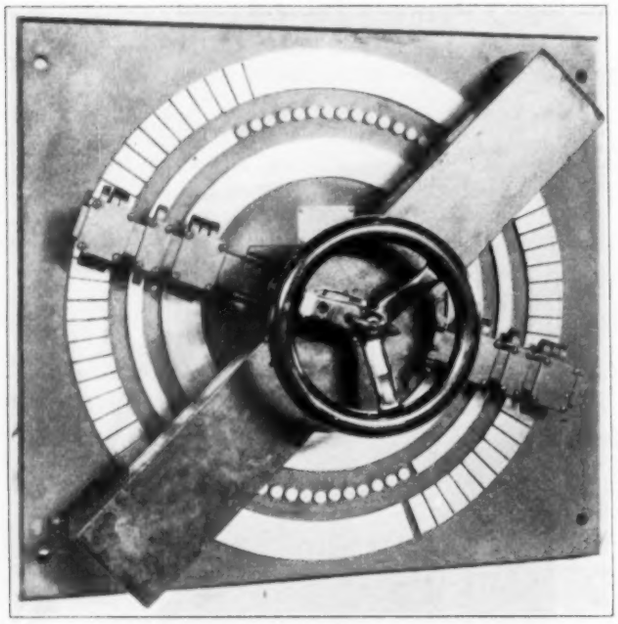


Fig. 4. The Welded Bracket Illustrated in The Drawing of Fig. 3. Note The Neat Appearance Afforded by Welding.

bolted together. Note the number of places where the angles have been cut out as mentioned in the above paragraph. Each of these angles had to be shown in detail on the drawing. Also, an assembly drawing was necessary. The bolts and nuts must be specified as to size and quantity by the draftsman. Hence, it is evident that valuable drawing room time is saved in the case of the welded frame as only one drawing was required.

There is a saving of time in the drawing room made possible

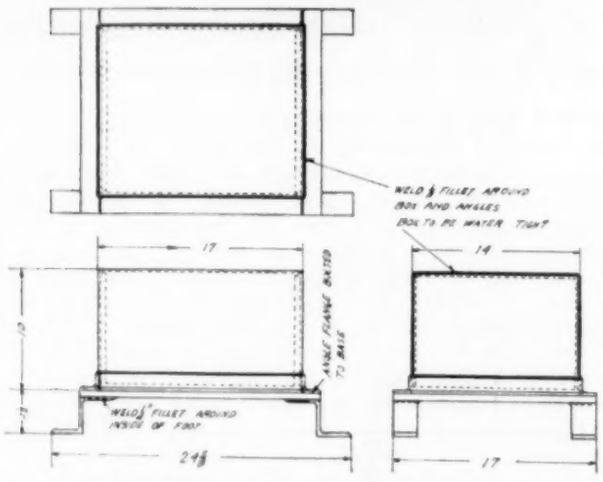


Fig. 5. A Welded Water-Tight Box That Was Made From a Simple Engineer's Sketch and Completed In a Very Short Time.

by the simplified drawings that can be used when making up the plans for welded structures. It is not necessary to detail every piece as was formerly done with a riveted or bolted structure. Parts that formerly had two or more holes in them for rivets or bolts can be welded in place without any fabrication other than cutting to length. In many cases one assembly drawing is all that is required to give the welder sufficient information to do the job.

The drawing in Figure 3 is that of a welded bracket. This is a regular working drawing with some of the dimensions for the drilled holes left off. The standard channel iron piece used gives the bracket a neat appearance. The completed bracket, bolted in place is shown in Figure 4. The appearance is further improved by placing the bolts which hold the bracket to the face plate in such a manner that they are hidden from view.

A water tight box made of welded sheet steel is shown in Figure 5. This box was a rush job. From an engineer's sketch on a piece of cross section paper, the shopmen completed the job in short order. Thus, the work was finished in less time than it would usually take to make the drawings if the box was made of cast iron or riveted construction. Here is one advantage of arc welding that is rendering large savings to its users.

The frame shown in Figures 6 and 7 was designed to support its load in any position. Also, it was designed to fit into as small a space as possible. Small channels and angles make up its parts which are joined by welding. As there are no protruding bolts or rivets, a larger inside area was possible than could be had with a bolted frame. This gave the frame greater strength.

Figure 8 is another welded frame of similar proportions but

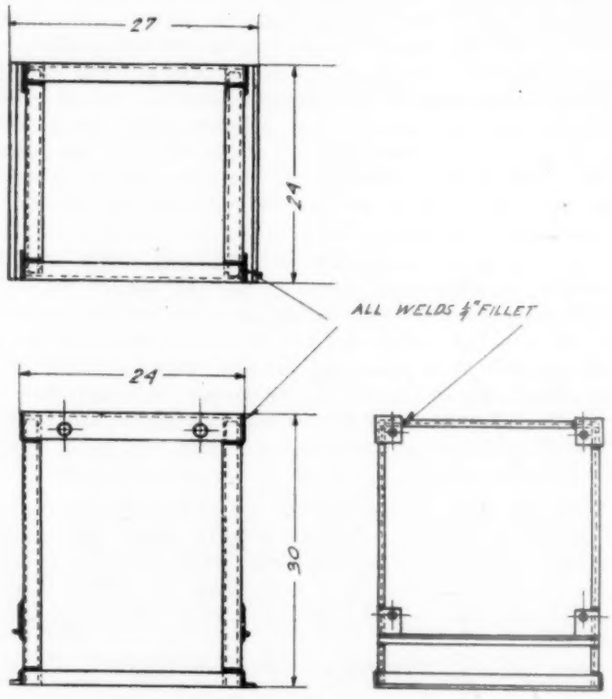


Fig. 6. A Welded Frame Made From Small Channels.

made entirely of angles. The top screen is shown in place. This screen was made of metal lath with a channel shaped edging welded around the edges.

Figure 9 is a picture of a bolted frame. The desirability of electric welding in building up a frame of this type is doubtless apparent to the reader after a glance at this photograph. Compare the clean-cut appearances of Figures 7 and 8 with this picture. The bolted frame has numerous bolts sticking out in many directions which make the piece look like a temporary job.

We have been so accustomed to seeing bolts or rivets at the corners and joints of structures that it requires a comparison such as this to make us conscious of the broken appearance of riveted structures. The smooth surfaces of welded pieces seem peculiar. They do not look just right. In time, however, when we have become used to this new construction, we will wonder why so many bolts and rivets were formerly used.

Fig. 7. The Frame of Fig. 6 After Completion. Compare The Smooth Appearance of This Frame With That of Fig. 9.
Fig. 8. Another Welded Frame of Similar Proportions. In The Design of This Frame it Was Felt That It Would Not Be Necessary to Weld The Angles All Around. It is Easy to See Where The Welds Could Have Been Continued.
Fig. 9. Compare With The Previous Illustrations For Lack of Smooth Appearance.

GAS PRODUCTS ASSOCIATION HOLDS WINTER MEETING AT CHICAGO

The Winter Meeting of the Gas Products Association, held at the Palmer House, Chicago, January 15th and 16th, was devoted principally to various matters of business, there being no program of technical papers, with the exception of one by Mr. G. W. Macauley, of the Grand Rapids Welding Supply Co., Grand Rapids, Mich., which was prepared as a message to this meeting regarding the progress being made in the adoption of welding by steamfitters. The discussion which followed brought out the fact that welding is being received with favor in those cities where the architects have been shown the advantages of a welded pipe line and where the steamfitters have been convinced of the interest to themselves in learning how to weld pipe. Schools have been established in several cities for training steamfitters and plumbers in pipe welding.

The new pipe welding film, Number Three of a series depicting convincingly the advantages of oxy-acetylene welding, was shown for the first time. This film presents a typical case of a piping contractor who convinces the builders of a large structure that welding will produce a better job at a saving to the owners, the advantages of welding being illustrated by welder-steamfitters on the job. The film is available for showing before interested organizations by arrangement with the Gas Products Association.

Important business pertaining to the association affairs was transacted at this session, including the question of a budget for the coming year to cover the projected activities, the retention of a secretary, the revision of membership dues and privileges, and the publishing of the association's house organ.

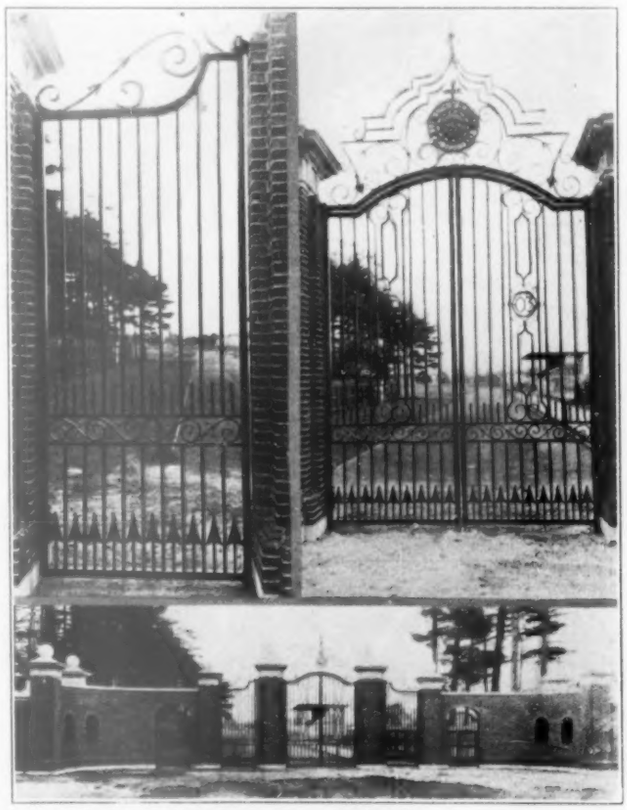
Mr. O. E. Engler presided in the absence of Mr. C. O. Epperson, President. An informal dinner on Wednesday evening was attended by the majority of those present.

C. G. M. A. ANNUAL MEETING AND DINNER

At the Hotel Astor, New York City, on January 21st, the Compressed Gas Manufacturers' Association will hold its sixteenth annual meeting and dinner. The meeting will be opened at 10 A. M. with the reading of a number of interesting and instructive papers. Luncheon will follow at 12:30 P. M. and the meeting will resume at 2:00 o'clock. During the afternoon session a few papers will be presented and the regular business session will take place at which officers and members of the Executive Board for 1929 will be elected. In the evening the banquet will be the only scheduled function.

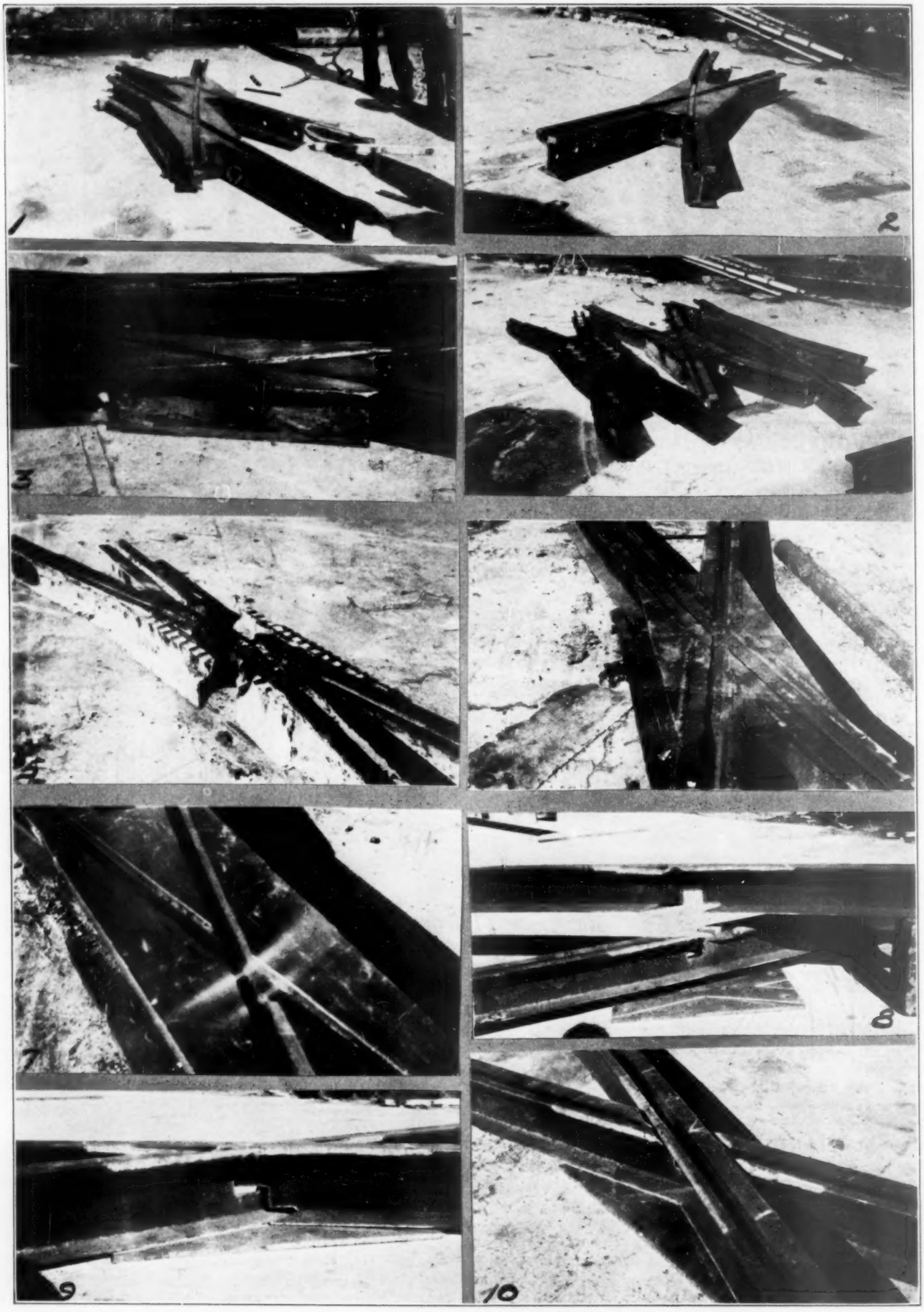
WELDED ORNAMENTAL IRON GATES PRESENTED TO BOWDOIN COLLEGE

These gates, designed by Harry S. Coombs, architect, of Lewiston, Me., were presented to Bowdoin College, Brunswick, Me., by the class of 1903. The welding was done by the Bath Welding Company of Bath, Me., using General Electric equipment. A total of 6,000 pounds of wrought iron was



Welded Ornamental Iron Gates Form Entrance to College Athletic Field.

required, all parts being bent and shaped in the shops of the welding company. General dimensions: 70 feet wide, 17 feet high at highest point; large center gate 9½ feet wide; others 4½ feet wide. Frames are of 2 x 2 inch square iron, and other sizes vary from 1 x 1 inch to ⅜ x ⅜ inch. The gates are situated among the pines of the campus at the entrance to the Whittier Athletic Field.



Design and Assembly of Welded Crossings and Frogs, Which Replace Castings at One-Fifth of Cost.

WELDED FROGS COST ONE-FIFTH OF CAST FROGS AND GIVE BETTER SERVICE

By C. Arnoldson, Jr.*

The problem of the high cost of frogs and crossings, as well as the cost of replacement and repair of parts, has been very successfully solved by the Ways Department of the Havana Electric Railway Company, Havana, Cuba. Frogs and crossings are now of all arc welded construction, no bolts, rivets, castings or forged fish plates being used. The plates are tied together with ordinary ½-in. boiler plate.

We not only make frogs for single replacements but we also make complete layouts for new work, including bending the curves and connecting the frogs and crossings. By this method we do not need any molds and can make the frogs any angle or shape. The frogs illustrated have all been welded by the Welding Department of our Ways Department.

Figure 1 shows a double frog all arc welded, made up into one solid piece of steel without the use of bolts, rivets or fish-plates, using ½-in. ordinary steel plate to tie 108-lb. Lorain (high guard) girder rail. One rail is curved (note good curvature) and the other two are straight. This double frog is to replace a worn out factory-made frog of the Iron Bound Guarantee Insert Type. We also make these frogs for new work. This home-made frog costs, including labor and material, $89.00, while the same from the factory costs about $450.00

Figure 2 shows a single frog arc welded with vertical side plates ½-in. thick to imitate the center casting of a factory-made frog. This frog was specially made to demonstrate that we could make a frog by welding not only as strong as a factory-made one but also to look it in every respect. The cost was $50.00, while the cost of the factory-made one would be about $250.00.

In Figure 3, in front is a close-up view of the center part of the frog of Figure 2. In back you can see a side view of the home-made frogs we usually make without the vertical side plates which imitate the castings. These cost from $42.00 to $45.00, still cheaper than the one in Fig. 2. As the vertical side plates are only for looks and do not greatly strengthen the frog, the extra cost is not warranted and we omit them.

In Figure 4, on the extreme left, is a factory-made frog costing about $250.00. In the center of the picture is our home-made frog of Fig. 2, imitating the factory-made one even as to casting, and costing $50.00. Finally, on the right of the picture you see one of our usual home-made frogs ranging in price from $42.00 to $45.00, depending on whether it is single or double curved. Savings such as this are worth considering by any railroad.

We make a frog in about three days, while it takes about three to four months to order same from the States. We do not have to worry about our factory-made frogs breaking down under traffic due to the casting failing or the hard center insert breaking beyond repair, because in about three days we have a home-made frog in its place. Our frogs cannot fail. When they wear down under traffic, we weld them to the proper shape, repairing the flange-ways and points with high-carbon or manganese welding wire, depending on the traffic conditions. This we have to do also to the insert plate of the factory-made frogs.

Factory frogs fail under traffic at the casting. Fig. 5 shows a typical break. Sometimes when new they are accidentally dropped due to careless handling, or when in the track only a short time they sometimes break due to a flaw in the casting. In our home-made frogs we have eliminated the weak point, which is the casting. Sometimes the hard center insert of a factory frog becomes loose and breaks, or due to repeated repairs by electric welding the crystalline structure of the material is changed and weakened and the plate breaks badly, and if the rest of the frog is badly worn it does not pay to put in a new insert plate. Our frogs are one solid piece of steel after welding the different parts together with mild steel wire. For the wearing portions on the center of the frog we use high-carbon or manganese welding wire. In Fig. 6 is the center top part of a home-made frog before grinding, and in Fig. 7, after grinding. We reinforce our frogs with plates in every direction possible.

We use the oxy-acetylene torch to cut out the plates and rails so as to fit them into one another, never cutting any of the rails clear through, but cutting enough of each so as to frame into one another. Straight rails are cut at the top, leaving the flange and a part of the web continuous, and the curved rails are cut at the bottom flange, leaving the top, guard, ball and part of the web continuous. Figures 8, 9 and 10 show how the cuts and framing are made.

Engineer of Ways, Havana Electric Railway Company

FOURTH MIDWEST POWER ENGINEERING CONFERENCE

What promises to be a large, very diversified and interesting exhibition of power machinery and power appliances will be held in the Coliseum, Chicago, at the Fourth Midwestern Engineering and Power Exposition, February 12 to 16, inclusive. While this panorama of progress of power machinery is unfolded at the Coliseum, noted leaders of the power engineering world will discourse on important technical problems at the Palmer House.

The program will consist of many technical papers on power plant construction, management, and maintenance, with one session devoted to heating, ventilating, and refrigeration, and another to power plant operation. During the latter session, which will be held on the afternoon of Thursday, February 14th, a paper entitled "Welding in Power Plant Construction and Maintenance," will be presented by Mr. H. H. Moss of the Linde Air Products Co., New York, N. Y. This paper will obviously be of much interest to those engaged in the welding industry and many other of the talks will contain matters of interest also.

BRITISH INDUSTRIES FAIR OF 1929 EXCEEDS THAT HELD LAST YEAR

The fifteenth British Industries Fair will be held concurrently at the White City, London, and Castle Bromwich, Birmingham, from February 18th to March 1st. The Fair as a whole is under the auspices of the British Department of Overseas Trade. As usual the lighter trades will be held in London and the heavier in Birmingham. Coming just before the Leipzig Fair, opportunity will be afforded visitors from abroad at the British Fair to attend the latter event in the same journey.

Following on the success of the Fair in 1928, space has been applied for on a greater scale than ever before. The Birmingham section will include exhibits of welding rods and gas and electric welding equipment, in addition to electrical machinery, foundry equipment, and heavy machinery for mining, shipbuilding, and various other metal working industries.

Full information regarding the Fair, admission tickets and free visas can be obtained from any British Consul.

NEW YORK SECTION AND A. S. M. E. HOLD JOINT MEETING

A combined meeting of the American Welding Society and the Metropolitan Section of the A. S. M. E. was held in the Engineering Societies Building on January 8th. Mr. H. H. Moss of the Linde Air Products Company, spoke on "Training and Management of Welding Operators for Pressure Piping and Vessels," and the subject of "The Present and Future of Welding in Power Plants" was presented by Mr. P. W. Swain, Managing Editor of *Power*.

Testing the "Average" Weld

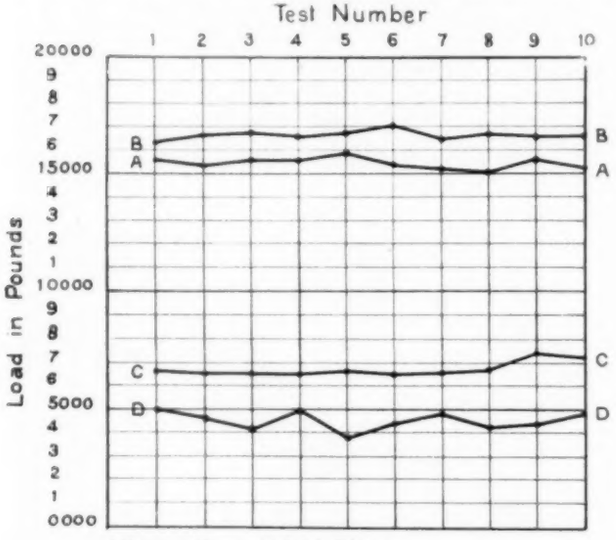
Joints Made by Oxy-Acetylene Welders in Small Blacksmith Shops Prove Stronger Than Bolted and Riveted Connections

By J. G. Dent*

DUE to the apparent lack of general information and difference of opinion on the merits of bolted, riveted, and welded joints, a series of tests were made to supply some of the information.

Common mild steel, 1x¼ inch was selected as being best suited for the tests.

It was thought best to make up the bolted and riveted test



Strength of Mild Steel

1X¼ in.		Average Load	
A	Cold	15500 lbs	100%
B	Annealed	16590 "	107%
	Bolted Joints		
C	6 S.A.E. Cap Screws-¼ in.	6810 "	44%
D	6 U.S.S. Cap Screws-¼ in.	4550 "	29%

Graph I.

pieces in the laboratory, as nearly as possible at the same time and under the same conditions.

The blacksmith and oxy-acetylene welds were to be made by welders in various parts of Minnesota and adjoining states.

In starting the series of tests, ten bars of 1x¼ inch mild steel were taken at random, a piece 18 inches long cut from each and tested. The results are shown in graph I curve "A." The 15,500 pound average was taken as 100% in figuring the percent of all following tests.

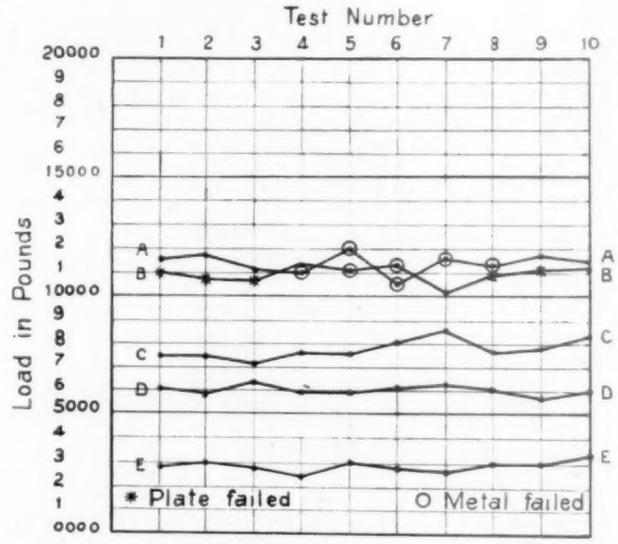
Ten pieces were then cut from the bars and annealed by heating to a bright red and cooled slowly in the air. The results are shown in graph I curve "B." Because forge welding heats the metal for a considerable distance each side of the weld and because of upsetting the ends and hammering, it was thought this might increase the strength of the test piece to some extent.

Ten tests were then made using a plate six inches long of the same material, bolted on with six ¼ inch S. A. E. cap screws. The results are shown in graph I curve "C."

In curve "D" six U. S. S. cap screws were used. These show less strength than the S. A. E. because the threads were cut nearer the head and they sheared in the thread.

Graph II shows riveted joints. In curve "A" a six-inch plate was placed on each side of the joint, held with six rivets. In test numbers 1, 2, 3, 9 and 10 the rivets sheared. The metal failed in the others. If the rivets in the end of the plates were placed in the center, the rivets sheared, if staggered the bar failed.

In curve "B" a 12 inch plate was used with 12 rivets. In five tests the plate failed, the bar in two and the rivets sheared in three. Curve "C" shows rivets put in red hot, at "D" and "E" cold.



Riveted Joints

	1X¼ in Mild Steel	Average Load	
A	6 Rivets, ¼" 2 Plates	11,530 lbs.	74%
B	12 " " 1 Plate	11,040	71%
C	6 " " Hot	7,830	50%
D	6 " "	6,070	39%
E	4 " "	3,980	25%

Graph II.

With the work complete thus far, came the task of getting welds from various welders. This was quite a task inasmuch as we were insulted, sneered at and almost kicked out of some shops; while in others they were glad to make the welds and some were even willing to pay for the tests.

Approximately 40 blacksmiths and about as many oxy acetylene welders were called on and asked to make three test welds each. Out of this number twenty of each consented.

The workmen were asked only to give their time as the metal was furnished, cut to length and numbered. Each man was asked to make three welds using the same methods that would be employed for any customer. They were instructed to make the weld a little oversize that it might be dressed down to the bar size before testing.

Trips were made in Minnesota and over the border into Wisconsin, Iowa and South Dakota. Some towns had no

*Instructor, University of Minnesota.

blacksmith shop, some no acetylene welder and a few had neither. Many towns that had two or three blacksmith shops a year or more ago, now had only one.

In some cases the blacksmith also did acetylene welding, sometimes being the only welder of either kind in the town. Many of the garages doing acetylene welding did only their own work.

None of the blacksmiths had attended a trade school. Only one acetylene welder had attended a short course. A few of the acetylene welders were former blacksmiths. All of the blacksmiths making the forge welds had been in the business at least ten years and at least one over forty years.

Most of the acetylene welders had been at the business less

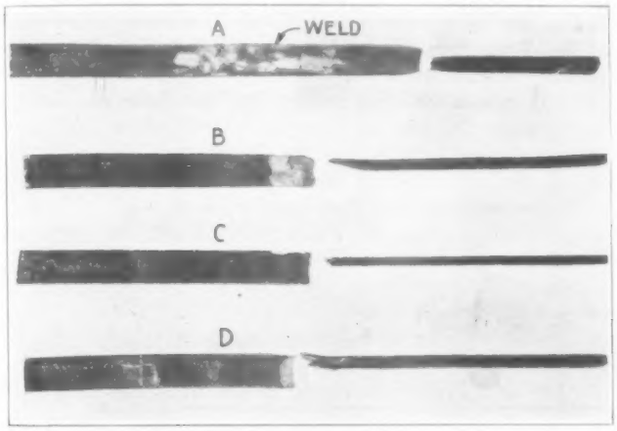


Fig. 3. Specimens of Forge Welds Which Withstood Tests.

than ten years and some only a few months. Some of the acetylene welders had made a study of the process and seemed to understand what it was all about while others were just metal melters.

Many of the forge welders were absolutely sure their welds would never break, yet 53 out of 60 did break in the weld, as compared to 55 acetylene failures in the weld.

Nearly all of the blacksmiths and many of the acetylene welders considered the forge weld the better of the two. However, the results of this survey seem to indicate that if the acetylene welders had had the years of experience that the forge welders have, the acetylene welds would equal the forge welds in tensile strength.

After the last of the 120 welds had been collected and tested, the results were put in table form showing the pounds tensile strength of each weld. This table was blue printed and sent to each of those making the welds. It is planned to return part or all of the welds later. No doubt considerable benefit will be derived by the welders from seeing the results of their work and comparing them with others. Seeing the defects in the broken welds should also be helpful. Some requests for a second try have been received and one blacksmith who got a 90% average on his first three forge welds got 97% on his second lot. Only the first trials are recorded in this survey, however.

Cost of Welding

As the welds were being collected, data was also taken on prices charged for regular commercial work of this size. Some shops where the work was guaranteed charged as high as thirty-five cents each. The average price asked was twenty-five cents each for either kind of weld.

Summary

All tests were made on a Riehle Brothers 50,000 pound testing machine at the Division of Agricultural Engineering, University of Minnesota, 1927-28.

Blacksmith Forge Welds

Of the 60 welds tested, 53 failed in the weld, most of them along the line of weld all or part way.

Of the 7 welds which did not fail, 5 were not affected by the strain, the bar necking down and failing several inches from the weld. (See "A," Figure 3.) The other two failed about one inch from the weld. Two out of the twenty welders got 100% averages. The average for the 60 welds is 89%.

All welders upset and scarfed the two ends. All except one used a commercial flux. This man did not use a flux. All welders were instructed to air cool their welds.

The pieces were lapped from ½ to 1½ inches and hammered nearly down to size. The short lap tests were very poor. All welds were ground and filed to the bar size before testing. The testing machine grip seized the bar approximately 6 inches each side of the weld. The bars commenced stretching at from 11,000 to 12,000 pounds.

The overheated and slightly burned weld was stronger than the underheated one. Nearly all of the welds pulled apart along the line of weld without tearing the metal except at the scarfed ends and sometimes not even there. This would seem to indicate that the metals were nearly always underheated.

The line of weld showed rather plainly before testing, in most cases.

Clean orderly shops usually turned out the best job and in almost every case the man taking the more time boasting

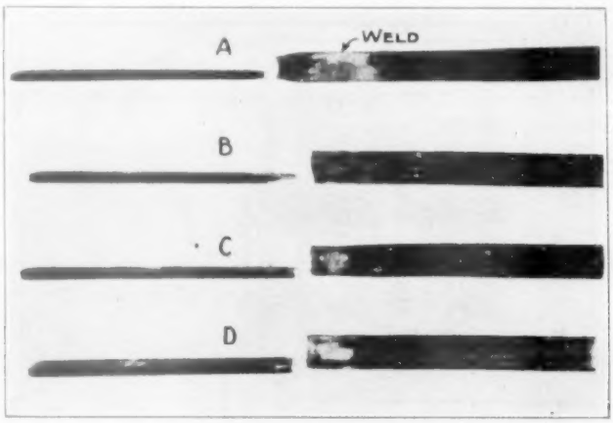


Fig. 4.—Specimens of Oxy-Acetylene Welds Which Showed Unusual Strength.

about his work than it took to make the three welds, was one of the low men.

The time required to make the three welds ranged from 10 minutes to 1½ hours. Both these extremes were low tests.

Oxy-Acetylene Welds

Of the 60 welds, 55 failed in the weld. The 5 welds which did not fail were not affected by the strain and the bar failed a considerable distance from the weld. (See Figure 4—"A.")

Two welders each got 100% average on their welds, as compared with two forge welders. Both these acetylene welders conducted welding shops and used the butt method, puddled and lightly hammered.

Nearly all welders ground the metal to a "V" on each side and practically all of these showed a poorly welded streak through the center.

The few who butt welded backed the ends apart from ⅛" to $\frac{3}{16}$". The better workmen seemed to favor a large welding tip, completing the job much quicker than where a small tip was used.

Nineteen out of the twenty acetylene welders used commercial mild steel welding rods, practically all copper plated. One used a common mild steel rod getting an average of 82% in the tests.

Those who used the puddle method got better results than the ripple, and lightly tapping the white hot completed weld with a hammer seemed to add strength.

Acetylene welding heated the bar only a short distance from

the weld while the forge fire anneals the bar for a considerable distance.

Some of the acetylene welders did not weld with a neutral flame and many of the welds showed effects of burning.

The grip of the testing machine seized the bar approximately 16 inches each side of the weld. The average tensile strength of the 60 acetylene welds was 84% as compared to 89% for the forge welds. No tests were made of electric welds because of the scarcity of welding machines in the smaller towns.

SUMMARY TABLE

Tensile Strength of 1x1¼″ Mild Steel Bars and Joints

Kind of Joint	Average Lbs.	Percent
None (plain bar)	15,500	100
None (annealed)	16,590	107
6 S. A. E. ¼″ cap screws	6,810	44
6 U. S. S. ¼″ cap screws	4,550	29
6 Rivets, ¼″ 2 plates	11,530	74
12 Rivets, ¼″ 1 plates	11,040	71
6 Rivets, ¼″ hot	7,830	50
6 Rivets, ¼″ cold	6,070	39
4 Rivets, ¼″ cold	3,980	25
Forge weld[1]	13,775	89
Oxy-acetylene weld[2]	13,000	84

[1]—Minimum, 7,420; maximum, 16,250. [2]—Minimum, 7,620; maximum, 16,280.

THE RAPID ADVANCEMENT OF ARC WELDED CONSTRUCTION DURING 1928

By A. M. Candy, General Engineer, Westinghouse Electric & Manufacturing Company

The use of arc welding for fabrication of buildings, bridges, and machinery in particular has grown at a rate during the past year that has surpassed the imagination of the most ardent welding enthusiasts of a few years ago. Like all new processes the acceptance at first is restricted to certain small groups after which the general adoption follows:

Building Construction:

In the building field the construction of a 987 ton mill type structure by the American Bridge Company at Philadelphia, Pa., has been outstanding. A 250 ton combined office and bank building has been completed at North Tonawanda, New York, for the Tonawanda Power Company by the Fort Pitt Bridge Company of Pittsburgh, Pa.

A very unique building project has just been completed at Hot Springs, Va., for the Homestead Hotel which involved an eleven-story steel addition to the Hotel, requiring about 500 tons of steel. The unique feature of the project was a clause in the contract requiring that erection of all steel be attended with no noise to annoy the guests of the hotel. As a result of this clause arc welding as a fabricating and erection means was selected. The process not only relieved all guests at the old hotel of any annoyance of riveting but also proved to be an actual source of interest and entertainment as most of them had never seen the process used before.

At the East Pittsburgh Works of the Westinghouse Electric

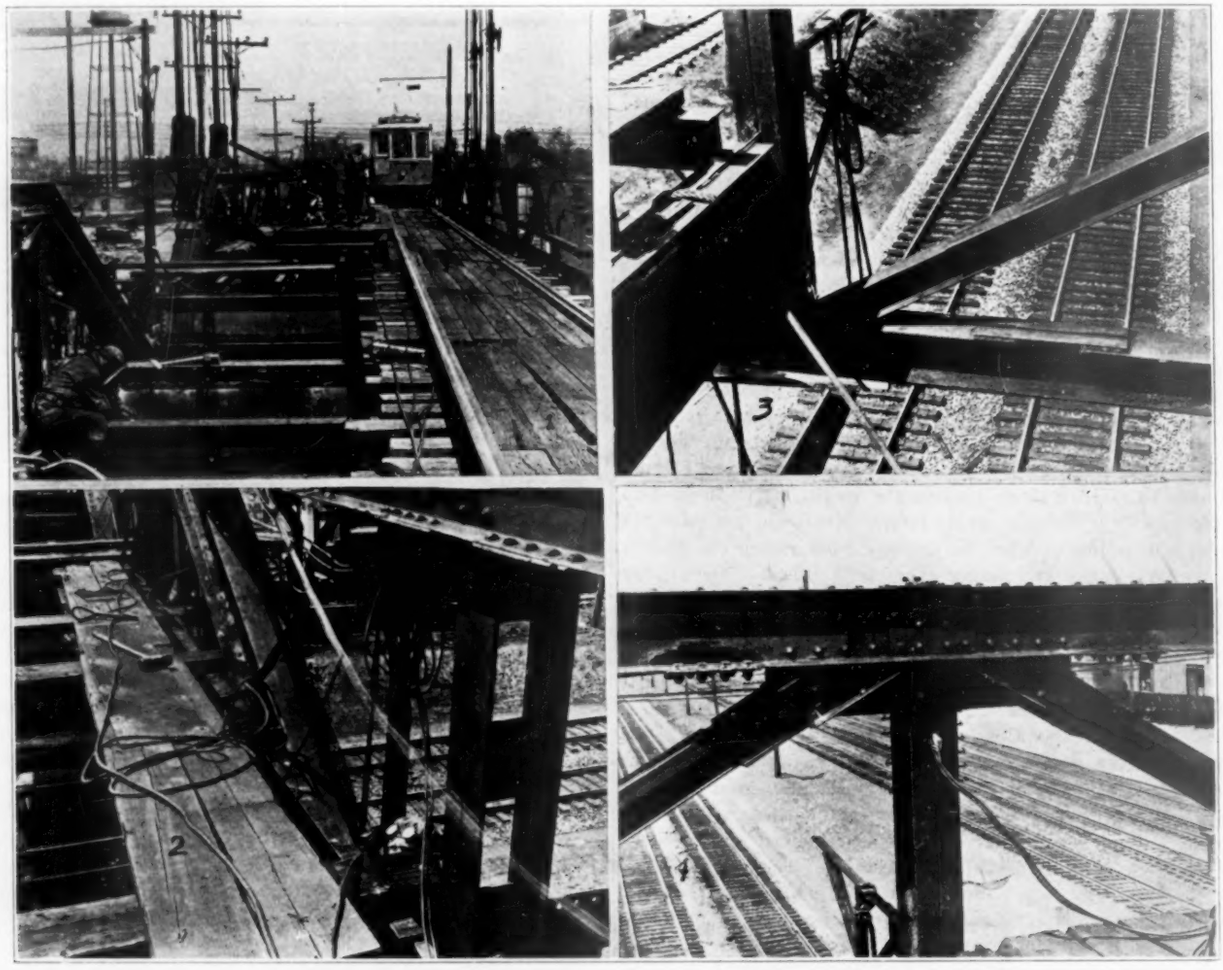


Figure 1. Public Service Corp. of N. J. Combination Trolley and Highway Bridge Reenforced and Reconstructed by Arc Welding.
Figure 2. Carnegie Beam Which Was Pushed Up Through Lattice Girder and Welded in Place After Which Lattice Bars and Evenetually the Channels Were Cut Away With a Gas Torch.
Figure 3. Shows Peculiar Form of Spliced Connection to Permit Slipping New Members Inside of Old Lattice Girders Before Welding New Members in Position and Cutting Away the Old Members.
Figure 4. Inasmuch as Top Cord Members Were Good the New Beams Were Welded to the Gussets and Old Channels of Latticed Girders Were Cut Away Around Outline of the Gussets.

and Manufacturing Company an arc welded building has been erected solely to house the rolling mill and welding equipment to produce a complete line of arc welded direct current motors and generators.

Bridge Construction:

In the field of bridge construction at least two very interesting projects have been completed. The first of these is the single track railroad bridge at the Westinghouse Electric and Manufacturing Company, Chicopee Falls, Mass., plant. This bridge crosses a power canal fifty feet wide at the extreme angle of 72 degrees thus requiring trusses 135 feet long and resulting in a total overall length of about 175 feet. By taking all the advantage of welded construction possibilities the weight of the welded bridge was reduced materially below that of the riveted design. The cost was also materially reduced as indicated by

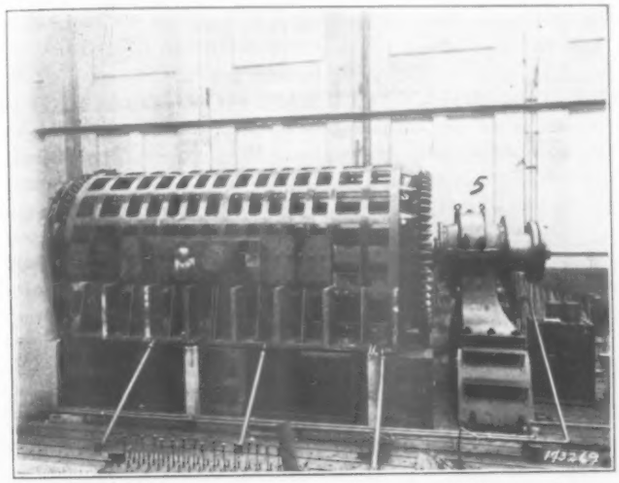


Fig. 5. Largest Turbo Generator Built to Date With Arc Welded Frame. Machine Capacity, 94,200 KVA, 13,200 V., 3 Phase, 60 Cycles, 1800 RPM; Weight, 265,000 lbs.

$19,000 as compared with $15,000 for the lowest riveted and welded bids respectively. This bridge was constructed by the Palmer Steel Company and erected by Tarbell and Leete Company.

Another very unique bridge project was completed at Bound Brook, N. J., for the Public Service Company. This operation involved reenforcing and reconstructing a combination highway and interurban railway bridge of two spans over the main line tracks of the Lehigh Valley and Central of N. J. Railroads. All reconstruction was carried out without interrupting either the interurban service or the R. R. service.

The unique feature of this construction involved placing new beam members inside the old latticed girders welding them in place after which the lattice bars were cut away. This method of construction required the use of specially designed splice joints. When the new beams were completely secured, the remaining channel members of the lattice girders were cut off at the gusset plates. Not all the members but only those in a bad state of corrosion were renewed. The entire project was carried out at much less expense than if the members had been replaced by riveting.

Machinery Construction:

In the field of machinery construction arc welding has advanced with even greater strides from the manufacture of small motor bedplates and frames to the construction of the largest turbine generator frame ever built for 1,800 RPM, namely, a 94,200 KVA machine. In fact, this welded construction has advanced to the point where more than 600 tons of steel per month is used by one large manufacturer building such machines.

While this advancement has been spectacular and rapid it has been the result of a step by step development. The first step was to use welded end bells. This was followed by the introduction of welded bedplates constructed of commercial shapes. The next step was the development of completely fabricated frames and rotors. The last step was to produce a fabricated bearing bracket per Figure 10, which gives a completely fabricated and welded machine.

Advantages of Arc Welding:

All of this work and development has taken place due to the proven advantages and sheer merit of arc welded construction. In the field of buildings, bridges and similar structures the principal advantages are:

1. The weight of material in fabricated beams and girders can be reduced 18% to 25% by designing for arc welding instead of riveting.
2. No material need be removed from columns or tension members such as rivet holes and, therefore, in many cases smaller members can be used for welded construction.
3. The weight of material for connections can be reduced by 50% to as high as 90% in some cases as compared with the requirements of riveted construction.
4. Absolute fixation of one member to another can be readily obtained.
5. Continuity of lines of beams or girders can be readily obtained permitting the use of smaller members in many cases.
6. Much greater rigidity can be produced in a properly designed welded structure.
7. Overlapping members can usually be completely sealed by weld metal, thereby, excluding moisture and preventing corrosion between the "Faying" surfaces.
8. A welded structure is much easier to paint than a riveted structure.

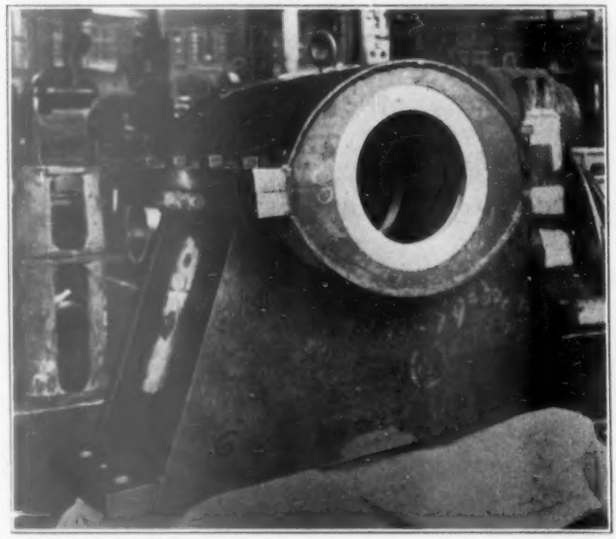


Fig. 6. Large Pedestal Bearing Housing Constructed by Arc Welding Using Steel Plate and Bar Stock.

9. Changes in or additions to structures can be made in the field with great saving in both time and expense.
10. In many cases simplified and more pleasing designs are possible with welded construction.
11. Roof trusses can be constructed with much greater symmetry thereby reducing secondary stresses.
12. The welding process is practically noiseless which is an asset for both shop fabrication and particularly field erection work.

In the field of machinery design and construction the advantages of using arc welded shapes, plate and bar stock to produce a substitute for similar cast iron structures are even more outstanding due to the inherent advantages of commercial rolled steel over cast iron and the advantages of the fabrication process over present day foundry and pattern shop practices.

The ultimate tensile strength in pounds per square inch of the materials are:

Cast iron	22,000 lbs.
Rolled steel	55,000 lbs.

The modulus of elasticity of the two materials are:

Cast iron.....12,000,000

Rolled steel.....30,000,000

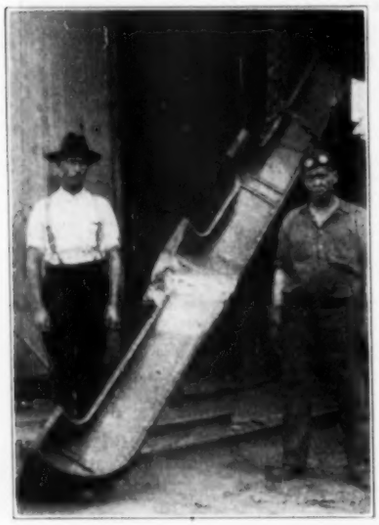
In addition to these outstanding physical advantages of rolled steel we find that pattern making and foundry practice often handicap the designer by requiring sections in casting much heavier than demanded by strength considerations. Due to these and other factors we find the following advantages accruing to arc welded machinery.

1. Weights in many cases have been reduced as much as 50%.
2. Costs have been reduced due to elimination of pattern and core making, and decreased machining work.
3. Simplified details of design have been made available by welded construction.
4. Homogeneity of metal is much more definite in rolled steel than in castings.
5. Delivery dates have been materially reduced due to elimination of pattern and core making.
6. Pattern storage charges are eliminated.
7. Casting scrapping due to sand or blow holes is eliminated.
8. Repairs to welded machines are much less likely to be required and when required are much more dependable and less expensive.

Based upon the developments and applications during the past two years in particular we believe that the arc welding process will be used extensively in the next few years in structural steel fabrication and erection work. Also that eventually the use of welded construction to replace castings for machinery will be even more extensive.

INDUSTRY ADOPTS WELDING AS LOW COST INSURANCE

Many manufacturing and industrial plants, located in isolated spots throughout the length and breadth of this nation, have long ago come to the realization that it pays to employ a competent welder about the plant. In the past, when a machine, or a part broke there was added to replacement cost, the additional expense of lengthy shut downs while the new parts were being shipped from distant supplies.



Bronze Welding Mine Pump Cross Member Saves Time and Money.

Today, progressive superintendents realize the important savings which may be effected by the intelligent use of the oxy-acetylene process and as a result its application are found in most fields of industrial endeavor. Thus, today, when a machine breaks down, it is no longer a case of closing the plant and awaiting replacement parts. Repairs are now quickly made by the plant welder and considerable savings effected all along the line.

The following brief description of a bronze-weld repair job on a mine pump cross member is representative of what can be done in the way of saving time and money. The break, occurring in this heavy cast iron cross member, threatened to cause a complete plant tie up. Fortunately the plant had in its employ a competent welder and at his suggestion it was decided to bronze-weld. This decision was arrived at in order to eliminate preheating, which is necessary for cast iron welding, and the possibility of the piece getting out of alignment. The crack was first veed out with a pneumatic chisel, top and bottom. A wire brush was next used to remove all dirt or foreign matter from the vee. Then the cross member was set up on a surface plate and clamped in position so that it would remain true during the welding. Two welders, working together, completed the job in a little less than five hours. A standard bronze rod and a good quality to flux were used. The casting was back in service the next day and this particular company states that the application was so successful that in future all broken castings will be treated in a like manner.

Most plant superintendents will seldom find themselves confronted by such a problem as befell this particular mining company. They will, however, find occasion as a matter of routine to call in the welder for many minor jobs that are essential to the continuous operation of the plant. When necessity does arise for dealing with an intricate casting, by welding either with cast iron or bronze, the plant welding equipment will be found to be cheap insurance indeed.

KINITE—WHAT IT IS AND HOW TO WELD IT

Kinite is an air hardening alloy steel manufactured by the Kinite Corporation, Milwaukee, Wisconsin. The primary purpose of this metal is the manufacture of dies used in making metal stampings. The advantages claimed for Kinite are that it can be cast in one piece to intricate shapes, saving material and machining costs, and that it is easily hardened and tempered. It is remarkably resistant to abrasion and also to compression. It is guaranteed to last from three to six times as long between regrindings as any ordinary steel and it is said that longer runs than this have been made in practice. Kinite has been made in the form of castings for the past ten years and within the last year processes have been perfected for producing it in the form of rolled bar stock.

Since ability to resist abrasion is one of the outstanding characteristics of this alloy the manufacturers were asked some time ago if it could not be supplied in the form of welding rod to be applied on surfaces subject to abrasion. Considerable time was spent in developing such a rod and the company has succeeded in compensating for the various elements that are decreased or increased, depending on whether the welding is done by gas or electricity, consequently it is possible to use this metal for the wearing points of tools or parts without making the entire part of Kinite. It is supplied in ⅜ inch and ¼ inch diameters and in standard lengths. The following quotations from a booklet issued by the company cover the recommended welding procedure:

"Oxy-Acetylene Welding of Kinite Gas Welding Rod— The technique of applying "Kinite" by welding to worn parts or as a wearing surface or cutedge to new parts of steel, cast-iron, semi-steel or malleable iron, embraces all the general rules of correct oxy-acteylene welding of tool steel. The following suggestions are made to emphasize certain details of operation that will produce consistently good results.

"1. Have piece that is to be welded clean, free from heavy scale, sand or other substance. Large pieces should be preheated to red (1200° F.) or higher, and held at this temperature during welding procedure.

"2. With the piece to be welded correctly preheated, a small section of the area to be welded is brought to a sweating heat with the oxy-acetylene blowpipe using a reducing flame; that is, a flame with excess acetyelne that will show first a small green cone; second a large bluish green cone approximately twice the length of the small green cone followed by the deep purple (almost invisible) long flame. As the piece to be welded approaches a sweating heat which is easily seen when its surface becomes clean and mirror like, the blowpipe is inclined more and more to the horizontal and the Kinite welding rod is brought to fusion immediately above the section and allowed to flow and weld itself to the

pieces. By using a slightly waving motion with the sharply inclined blowpipe, the area immediately ahead of section being welded can be approaching the welding heat so that the welding itself can proceed almost continuously. It may be noticed that the rod should be removed and not again introduced until sufficient area is ready to be welded.

"3. Blow holes and cracks may possibly appear. Blow holes are due to slag and oxide inclusions, and can be eliminated completely. Blow holes are an indication of poor welding, and cleanliness and careful welding will eliminate them.

"4. Cracks in finished welds are the result of improper preheating; either uneven heating or not sufficient heating, and are eliminated in large pieces properly preheated by slowly cooling in a heated furnace, or covered with lime or sil-o-cel or asbestos wool."

"Electric Welding of Kinite Electric Rod—Kinite is supplied in 5/32 inch and ¼ inch diameter rod, especially prepared for electric welding. The cleanliness and preheating necessary in acetylene gas welding must also be observed in electric welding. Use reverse polarity.

"Open circuit of 40 volts, and welding circuit of 25 volts gives easily controlled arc and dense deposits. The 5/32 inch rod requires approximately 250 amperes and ¼ inch rod from 300 to 350 amperes. Amperage can be lowered with increasing temperature of the preheat, but must be kept high enough to maintain steady arc condition.

"The deposited Kinite is file hard. It can be rendered machineable by annealing and subsequently hardened. For numerous applications particularly where irregular shapes are involved this ability to machine the welded deposit is a decided advantage and will save considerable time in preparing the surface for service."

TWO NEW SALES COMPANIES INCORPORATED

The Milburn Sales Corporation and the Milburn Paint Spray Corporation have been incorporated under the laws of the State of Maryland to carry on the sale of a number of the products manufactured by the Alexander Milburn Company, Baltimore, Maryland.

The Alexander Milburn Company was founded in Baltimore over twenty-one years ago by Mr. Alexander F. Jenkins and manufactures welding and cutting apparatus, gas regulators, gas generators, portable lights, paint spray guns and guns for greasing purposes, besides other specialties. Milburn products have a world-wide recognition and use and are adopted as standard equipment of many of the large railroad, automotive, engineering and contracting industries, as well as governmental departments.

Milburn Sales Corporation takes over the selling of all equipment manufactured by the Alexander Milburn Company with the exception of the paint spray equipment and air guns for greasing purposes. The sale of these is being exclusively taken over by Milburn Paint Spray Corporation.

Each company has an authorized capital stock of 6,250 shares, divided into 2,500 shares 7 per cent preferred stock, $100.00 par value and 3,750 shares of common stock, no par value.

The officers of Milburn Sales Corporation are Alexander F. Jenkins, president and treasurer, Edward P. Boyer, vice-president, Louis J. Herzog, secretary, the same being directors in addition to J. Kemp Bartlett, R. Jenkins, M. Wunder and Clarence H. Hildreth.

The officers of Milburn Paint Spray Corporation are Alexander F. Jenkins, president and treasurer, Edward P. Boyer, vice-president, Robert M. Zimmermann, secretary, the same being directors in addition to J. Kemp Bartlett, R. Jenkins, Clarence H. Hildreth and M. Wunder.

The business of the Alexander Milburn Company has grown to such an extent that it was found desirable to establish separate selling organizations for its products. The financial report of the corporation, which states that it closed the year 1928 with all obligations, even to current accounts payable, fully paid, indicates the success which this company has achieved. On December 31st, the Alexander Milburn Company declared its 56th quarterly dividend of 1¾ per cent upon the preferred stock and the regular quarterly dividend of 2 per cent upon the common stock of the corporation.

THREE WELDED LINES SUPPLY STEAM TO CHICAGO SKYSCRAPER

The fact that the magnificent new building of the Chicago Daily News will have no heating plant calls for a long pipe connecting with the heating system of the Union Station. This line was originally laid out in the plans as a flanged fitting job, but the contractor who was given the work recommended welding, on the basis of his experience in other large installations. The building engineers declare that they are entirely satisfied with the welded job, this line having already demonstrated the advantages of welding large diameter pipe instead of using mechanical fittings.

The Three Welded Lines Suspended From the Ceiling of the Union Station Train Shed.

The actual cost of installation is less, the work of insulating is greatly simplified, and maintenance costs, it is expected, will be practically eliminated. Two of the lines, each 1,300 ft. in length, are of 6-in. steel pipe, the third, nearly 1,400 feet long, is 10-in. pipe, a total of about 4,000 feet. The pipe was delivered in 20-ft. lengths, beveled at the mill, and oxy-acetylene welded from a scaffold so that the line could be suspended on roller brackets as shown in the illustration. The long stretch shown is at one side of the train shed of the Union Station, and is subject to wide variations in atmospheric temperature. Expansion and contraction are taken care of by expansion joints and also by proper anchoring so as to take advantage of bends in the line.

BOOK REVIEW

ARC-WELDING MANUAL, published by General Electric Company. This is the third edition of a manual that covers most thoroughly the numerous applications of arc welding. The rapid advancement of the welding art and recent improvements in welding methods and equipment have made necessary a complete revision of previous editions. The first and fourth chapters constitute a text on arc welding procedure, with a description of the apparatus and equipment required and a course of instruction, including 40 practical lessons. Another chapter is devoted to the subject of symbols, definitions, and types of joints. Succeeding sections cover expansion and contraction, weldability of metals, testing of welds, automatic arc welding, atomic hydrogen welding, and the more important applications of metallic arc welding, such as the fabrication of structural steel, tanks, pressure vessels, pipe, and heavy machinery. The book contains 200 pages and is excellently illustrated. It can be secured for $2.00 a copy from the General Electric Company at Schenectady, N. Y., or from any of the company's branches.

VICTOR EXPAND ORGANIZATION AND CAPITALIZATION

Notice has been received from Victor Welding Equipment Co., formerly called "Victor Oxy-Acetylene Equipment Co." of San Francisco, Calif. that they have increased their capitalization materially, have changed the Company's name for the purpose of simplifying it, and have enlarged their sales field.

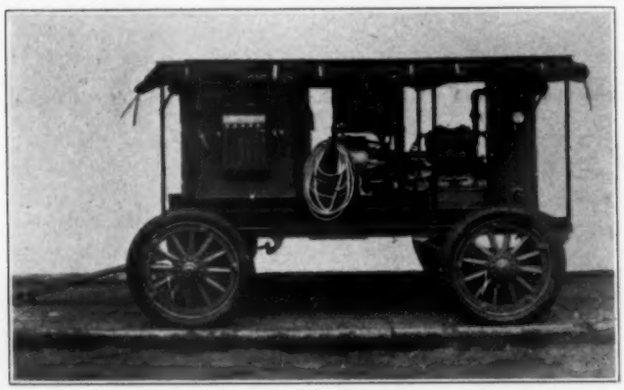
Victor Welding Equipment Co. manufacture a complete line of welding and cutting torches and pressure regulators, which are described very adequately in a new catalogue recently released for publication.

Victor have now established 14 distributing and service points west of the Mississippi River, and the program for 1929 includes the establishment of further stations in the Eastern territory.

The active manufacturing, engineering and sales management remains in the hands of those formerly in charge of these departments, with the exception of the withdrawal of Mr. and Mrs. F. W. Clifford, who have sold their interests and have retired. The extensive growth of the company necessitated the enlargement of its Board of Directors.

WILSON ANNOUNCES NEW WELDER WITH AIR COMPRESSOR

A gasoline-engine-driven arc welding generator, with an Ingersoll-Rand air compressor, has been added to their line of electric welding equipment by Wilson Welder & Metals



The New Wilson Arc Welding Generator and Air Compressor Set, Powered by Gas Engine.

Co., Inc., Hoboken, N. J. This machine is designed particularly to meet the needs of companies who do welding outside their own shops, where facilities for operating riveting and chipping machines and grinders are a convenience.

STEEL SALES ISSUES FOLDER ON WELDING RODS

A four-page folder just prepared by Steel Sales Corporation, 129 So. Jefferson St., Chicago, describes all of their gas and electric welding rods for welding ordinary carbon steels, high manganese, nickel, chrome, and vanadium steels, brass, aluminum and bronze, all sold under Steel Sales' own trade names. The booklet also describes the Wilson "Color-tipt" rods carried in stock. The description of each rod gives the sizes available and specifies the class of work for which the rod is especially suited.

D. B. McCLOUD LEAVES DUNHAM COMPANY

Announcement has been received of the resignation of D. B. McCloud, formerly connected with the Keith Dunham Company, Chicago. Mr. McCloud has been well known in the welding industry for many years. About ten years ago he was secretary of the Gas Products Association and at that time assisted in the organization of and served as a director of the Chicago section of the American Welding Society. He left that position to join the staff of an eastern manufacturer of heavy duty compressors. About six years ago he returned to Chicago to take a position with the Keith Dunham Company, whose principal activity at that time was the sale of air liquefaction oxygen producing plants. In the last two or three years he has devoted practically all of his time to the sale of liquid oxygen plants for the purpose of making L. O. X. explosive and to the study of the use of L. O. X. Mr. McCloud is now located at DuQuoin, Ill., where he is starting to organize a new business for the manufacture of L. O. X. cartridges.

GENERAL ELECTRIC BULLETIN DESCRIBES WELDING OF STEEL TIES

An interestingly illustrated eight-page booklet has just been issued by the General Electric Company describing the manufacture and use of arc-welded steel railroad ties, giving also the advantages of these ties over those of the common wooden type. The following claims are made for the steel ties: They hold the gauge of the track permanently; they resist the tendency of the track to shift on the roadbed; they do not burn when hot cinders are dumped on them, and they last almost indefinitely, making them cost less, in the long run, than the cheapest wooden ties.

This bulletin also describes the automatic arc welder which has been designed by the General Electric Company for manufacturing these ties.

ANOTHER WELDING COMPANY REPORTS RESULTS FROM ADVERTISING

The Welding Engineering Co., 1834 Howard St., San Francisco, is turning up new business and holding present customers by distributing a telephone index, which clamps onto the instrument and keeps the company's name and advertisement constantly before the customer. Mr. Edgar R. Chinberg of this company states that since they began using this handy device they have received many calls which can readily be traced to the advertising power of the little novelty.

LINCOLN APPOINTS TWO REPRESENTATIVES

The Lincoln Electric Company, Cleveland, Ohio, manufacturers of "Stable-Arc" Welders and "Linc-Weld" Motors, announces the recent appointment of new district sales representatives. J. E. Durstine has been advanced to district sales representative for the Southeast with headquarters at Birmingham, Alabama. A promotion places H. P. Egan as district sales representative for central Ohio with headquarters at Columbus, Ohio.

Gate valve which had been scrapped. Tobin Bronze welded and returned to service.

Money *Saved* by Repair-Welding Broken Parts *with* TOBIN BRONZE

Reg. U. S. Pat. Off.

THE gate valve illustrated was consigned to the scrap heap as the available means for making repairs were considered too costly and the results questionable.

An experienced welder who happened to be in the plant saw the valve and reported that he could Tobin Bronze Weld it at a nominal cost.

The cast iron body of the valve which was cracked clear around was welded with Tobin Bronze by the oxy-acetylene process without special pre-heating. It was returned to service as good as new, at a fraction of its original cost.

Many manufacturers are saving money by repair-welding broken parts with Tobin Bronze. Other concerns are using Tobin Bronze Welding to improve the quality of manufactured products and to reduce production costs. Tobin Bronze Welding Rods may be obtained from distributors of welding equipment and supplies. The name "Tobin Bronze" is stamped in every rod.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONN.
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS, LTD.
New Toronto, Ontario

ANACONDA
COPPER ANACONDA BRASS

ANACONDA
from mine to consumer

There is usually one best metal for every requirement.

The American Brass Company's Technical Department is prepared to help determine what this metal is and if the need can be met most advantageously with copper or an alloy of copper, to supply the metal in uniform, dependable quality.

"STANDARD"
Welding Wire
GAS AND ELECTRIC

for sound permanent welds : : lower costs
Our costs are considerably under those of large industrial centers; ours is a one-profit wire sold direct to user from our own mills exclusively devoted to making of welding wire from raw material to finished product—hence our extremely low prices for wire that is definitely superior. Adopted exclusively by many large users.
Prices on request.
A grade for each type of work—send for samples. Standard Steel & Wire Co., Greensburg, Pa. (Mills at Bolivar, Pa.)

WELDING ROD HOLDER
FOR THE OXY ACETYLENE WELDER
$1.00
ALL STEEL WIRE BRUSHES
SEND $1.00 FOR 5 ASSORTED BRUSHES
Money refunded on return of goods, if not what you want.
WRITE FOR DEALERS' PRICES
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ROBERT E. KINKEAD
ARC WELDING SPECIALIST
CONSULTING ENGINEER
3030 Euclid Ave. CLEVELAND, OHIO

GENERAL ELECTRIC ELECTS TWO COMMERCIAL VICE-PRESIDENTS

At a meeting of the board of directors of the General Electric Company on January 4 in New York, two commercial vice-presidents were elected, President Gerard Swope has announced. William J. Hanley, manager of the East Central District, with headquarters in Cleveland, and Charles K. West, manager of the Atlantic District, with headquarters in Philadelphia, have been elected vice-presidents in charge of the commercial activities of the company in their respective districts.

Mr. Hanley is one of the veteran commercial men of the company, his period of service dating clear back to the old Thomson-Houston Electric Company, one of the predecessors of the General Electric. He has been located in the Ohio region practically throughout his career.

Mr. West received his early training in General Electric sales work in the Charleston, W. Va., office. After ten years in the Charleston territory he was transferred to Philadelphia and placed in charge of various commercial departments in succession. He was made district manager in 1923 to succeed George P. Baldwin.

TAKES CHARGE OF ELKONITE SALES

Announcement has been received that Mr. J. A. Weiger of Elkon, Incorporated, has recently been appointed manager of sales for the Elkonite Department, effective January 2nd. Mr. Weiger has had a wealth of experience in the development of Elkonite and consequently is familiar not only with its production but also with its various uses in industry. The fact that his future activities will be concentrated entirely on Elkonite is expected to greatly increase the value of their service to customers.

WELDING ON TWELVE BRIDGES IN CHICAGO

Anchor Welding Service, 4715 Chicago avenue, Chicago, has taken a contract from the Chicago & Northwestern Railroad for welding twelve bridges in Chicago. The company is planning to enter the structural welding business. G. W. Hettrick is president, treasurer and general manager, and A. R. Jacobson is vice-president and secretary.

CORRECTION

The announcement of the new "Ideal" Electrode Holder on page 64 of the December issue stated in error that the manufacturer is the Federal Face Shield Co. The manufacturer of this holder is the Ideal Face Shield Co., of Columbus, Ohio.

NEW WELDING COMPANY INCORPORATED

Columbia Welding Company has been incorporated with $5,000 capital to engage in welding, brass foundry and machine shop business by William R. Rorer, 1120 Harrison street, Philadelphia.

Classified Ads

Help Wanted—75c per line, minimum 4 line
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

For Sale—One Wainwright Score Filling Machine. In first class order. Allan Mfg. & Welding Co., Buffalo, N. Y.

One Dollar will increase your earning power by bringing you any one of the following GUARANTEED FLUX FORMULAS — Cast Iron — Brazing—Copper—Nickel—High Speed Steel—Aluminum (sheet and cast). With instructions you can make up your own fluxes fresh. R. N. Robbins, 38 Winans Street, East Orange, N. J.

Wanted—Cleveland territory for welding wire and other gas or arc welding material. Small, healthy, well established welding service and parts company wants to expand. Address Box 170, care of The Welding Engineer.

For Sale—
1 Oxweld 35 lb. Acetylene Generator, $75.00.
2 Oxweld Oxygen Regulators, $10.00 each.
2 Oxweld Acetylene Regulators, $10.00 each.
1 Old Style Oxweld Cutting Torch, $25.00.
2 Oxweld Welding Torches with tip, 22 in. long, $15.00 each.
Herman Lambrecht, Sullivan, Ill.

Position Wanted—Welder with twenty years' experience. Five years oil pipe line; 6 years job shop. Some aircraft welding. Thoroughly experienced on aluminum. Gas and electric. DC and AC. Job shop in southwest or California preferred. Address Box 167, care of The Welding Engineer.

Position Wanted—As demonstrator of electric welding generators for manufacturer, or as welding wire salesman. Have had broad experience as welding supervisor, but desire traveling position in sales or service department of established manufacturer. Address Box 169, care of The Welding Engineer.

You Can Do It Better With TORCHWELD

Torchweld builds the best gas welding and cutting equipment. Far superior in design, material, workmanship, practicability and economical operation.

The quality of Torchweld products is unquestioned, the integrity of the organization is never doubted and its many years of existence have been of steady progress.

We aspire to build even better equipment and have added several new torches and regulators to our present line which should be of interest to you.

for

Progress

use

TORCHWELD

"Built to Stand the Abuse of Constant Use"

Write for Catalog No. 28.

TORCHWELD EQUIPMENT COMPANY
224 N. Carpenter St. CHICAGO

---*for* Strong welds

TRADE MARK REG. U. S. PAT. OFF

Nichrome

---*the exceptionally strong* Welding Rod

Welds made with "Nichrome" the nickel-chromium alloy, possess exceptional strength. For example, practical tests of welds on mild steel made with "Nichrome" rods, show an ultimate tensile strength as high as 55,000 pounds per square inch. It is interesting to note that the welding operation does not detract from the metal itself.

"Nichrome" welds are readily machinable and may be applied by either the oxy-acetylene or arc welding process. The ease of application and free flowing qualities of "Nichrome" welding rod, together with the fact that it can find wide application, makes its use extremely desirable.

Sample? If you are having difficulty in getting a strong weld, we are sure "Nichrome" will prove satisfactory. *Sample rods will be sent on request.*

DRIVER-HARRIS COMPANY
HARRISON, NEW JERSEY
Chicago - Detroit - Morristown, N.J. - England - France

Alloy Makers since 1899

Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

COMMERCIAL SERVICE
Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30-in. size	125 cu. ft. cap.
12x36-in. size	225 cu. ft. cap.
12x44-in. size	275 cu. ft. cap.

Commercial Acetylene Supply Company, Inc.

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Chicago, Ill.

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Boston, Mass.

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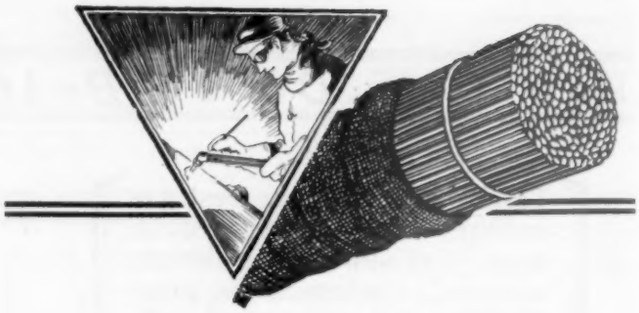
Atlanta, Ga.

417 Market Street
San Francisco, Calif.



WISSCO Welding Rods

give the utmost in welding satisfaction when your welding troubles are prescribed for by Wickwire Spencer Engineers.

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WISSCO WELDING RODS

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SOLDERS made with silver as a component part are solving many problems for metal-working industries. "Handy" silver solders flow freely, make a tight, compact joint, withstand much higher temperatures than soft solder and resist the attack of acids and other corrosive agents.

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Welding Wire and Electrodes

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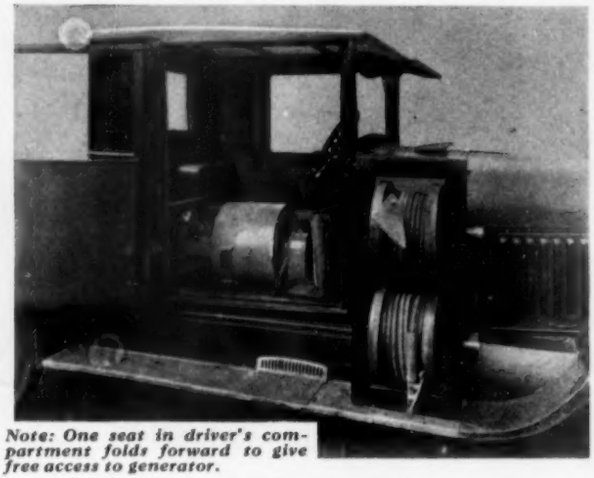
PORTABLE ARC WELDER



Note: One seat in driver's compartment folds forward to give free access to generator.

SPECIFICATIONS

GENERATOR: 300 amperes continuous; 400 amperes intermittent; ball bearing, 950 R.P.M.; extra heavy duty type.

POWER TAKE-OFF: Specially designed for welding service. Connected directly in drive line, provided with shifting lever for driving either car or generator.

GOVERNOR: Patented electric control. Does not affect car speed when generator is idle. Prevents surging of motor. Provides perfect inherent ampere control. Provides extremely elastic arc for all possible welding conditions.

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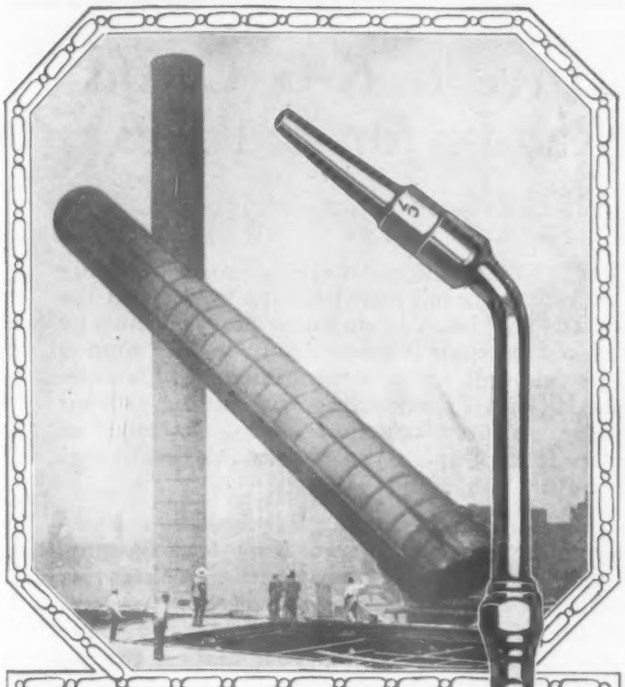

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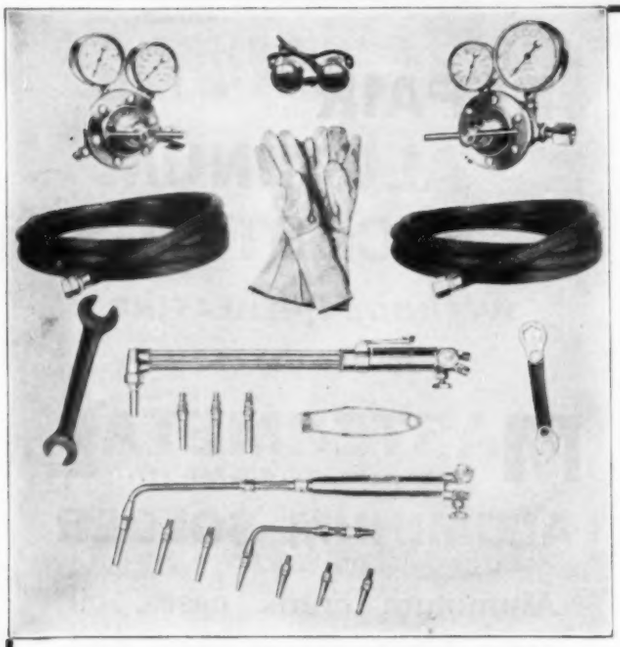

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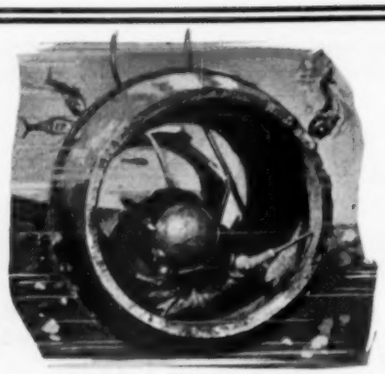

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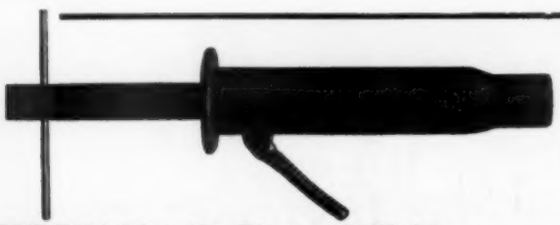

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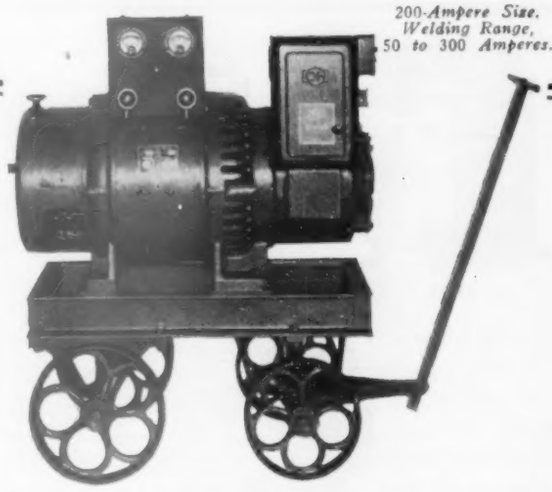

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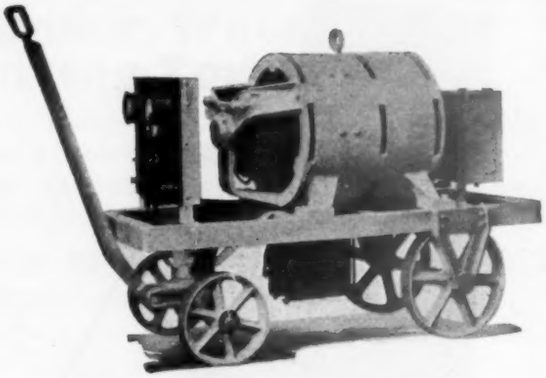

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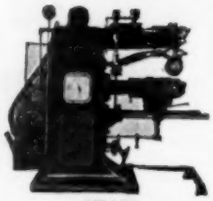

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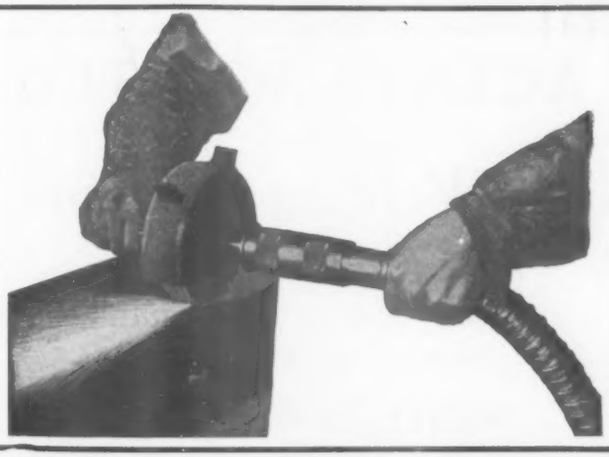

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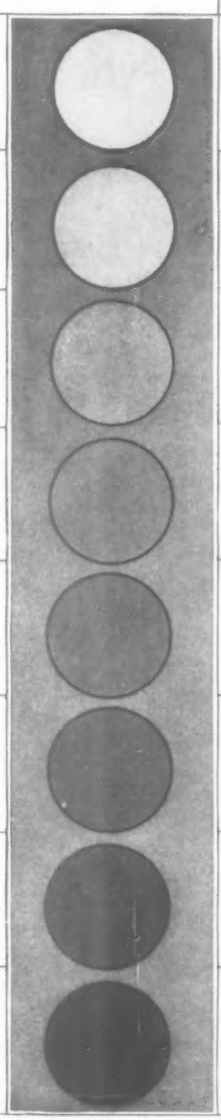
Shade No. 2		2.7 *per cent*	.5 *of one per cent*	40.3 *per cent*	Heating furnaces, welding observation, lead burning and other work involving low temperatures
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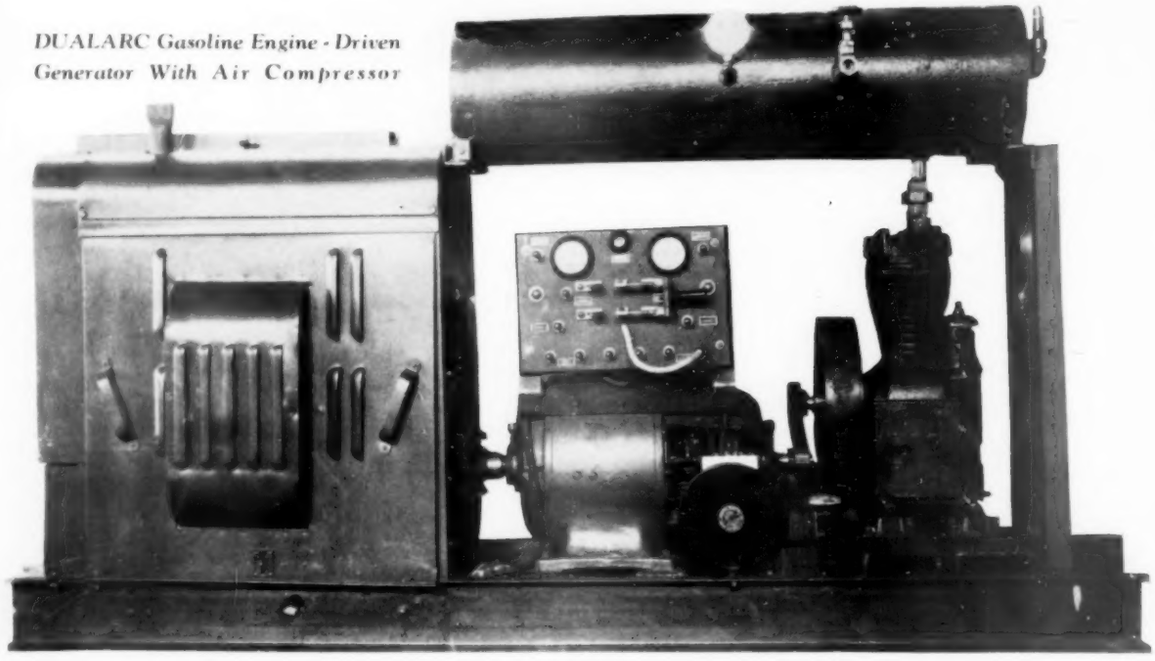

DUALARC Gasoline Engine - Driven Generator With Air Compressor

When it comes to

ALL-AROUND UTILITY

This machine "delivers the goods"

NO OTHER welder so completely provides for all of the operations that usually accompany welding on various classes of work. Equipped with a high speed air compressor, with chain or gear drive, and provided with 110-volt outlets for lights, drills, grinders, etc., as well as special provision for AC welding circuit for semi-arc flash welding, in addition to the well-known Dualarc advantages, the machine illustrated above is a complete plant capable of carrying through every operation on a large welding job.

Write for detailed specifications of the "Dualarc"

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